PLANKTONIC CRUSTACEA IN LAKES OF THE GREATER SUDBURY AREA

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SUMMARY AND CONCLUSIONS

Crustacean plankton were sampled in 187 lakes (including a high proportion of acidic lakes) in the Greater Sudbury area by means of vertical net hauls.

pH emerged as a major factor affecting the species composition and diversity of zooplankton communities in the study lakes. Lakes with pH < 5.0 contained consistently fewer species and fewer dominant forms than near-neutral lakes, consistent with the results of previous, less extensive, investigations. The simplification of crustacean plankton communities in acidic lakes may largely reflect altered predator-prey relationships and/or other factors, rather than strict pH limitation, since many species which occurred throughout the pH range assumed numerical importance only in non-acid lakes.

Although lake morphometry and transparency appear important in determining the distribution and relative abundance of individual zooplankton species within the study lakes, the overall importance of these controls on species richness is masked by the overriding factor of low pH.

INTRODUCTION

Under the Extensive Monitoring Programme of the Ministry of the Environment's Sudbury Environmental Study, limnological investigations were carried out on 209 lakes (see Map #1) within a 200 km radius of Sudbury, Ontario, during the years 1974, 1975 and 1976. The objectives of the Extensive Monitoring Programme were to document the extent of water quality problems associated with Sudbury smelting activity and provide a background data base to permit the determination of future changes and trends in water quality. Although predominantly on the Precambrian Shield, the lakes studied range widely in chemistry, morphometry and surficial geological setting, spanning a cross section of lake types occurring in Northeastern Ontario.

The major results of the Extensive Monitoring Programme, and the data base, have been published (Conroy et al. 1978) with emphasis on the presentation and interpretation of water and sediment chemistry information. The data showed the existence of a large zone of lakes with depressed pH (< 5.5) extending northeast-southwest from Sudbury. The low pH zone occupies an area of 5300 km^2 containing a lake surface area of 650 km^2. Significant elevations in water-borne and sediment-borne concentrations of trace metals, notably copper and nickel, associated with smelting activity, were also documented.

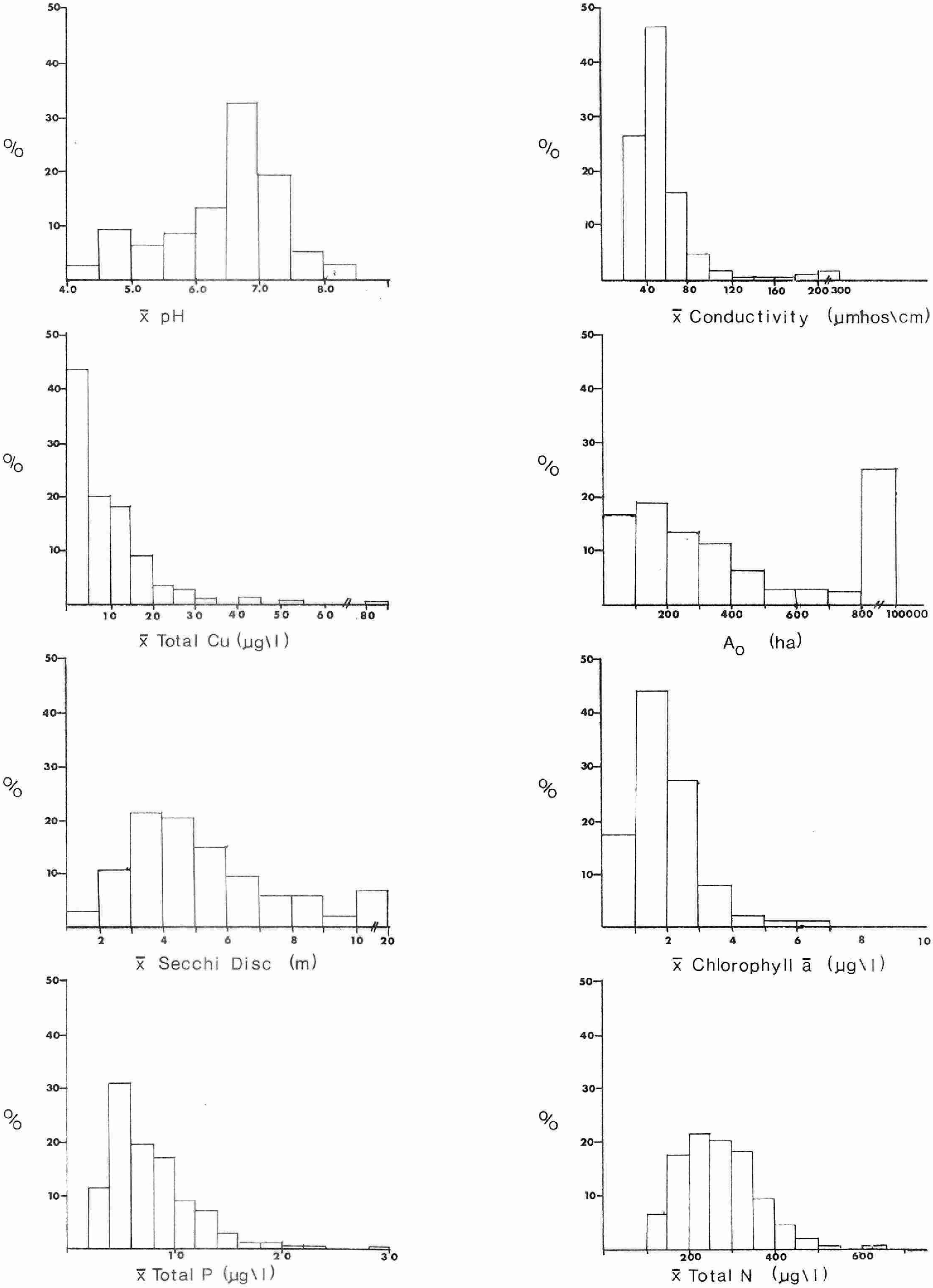
As part of the overall programme, crustacean plankton samples were collected from 187 of the 209 study lakes. These data were not provided in Conroy et al. (1978), since identification and enumeration procedures had not yet been completed. The present report presents the zooplankton data and discusses the results in relation to the pH, transparency and morphometry of the study lakes. A summary of the distribution of selected physico-chemical characteristics within the group of study lakes is provided in Figure 1.

METHODS

Except for a small number of tows (n = 13) taken through the euphotic zone (2X Secchi disc) in 1974, samples were collected as vertical net hauls from 1m above bottom to surface in an open basin of each study lake. During 1974, samples were taken with an 11 cm mouth diameter net (76 μ mesh) while during 1975-76 a 20 cm mouth diameter net (80 μ mesh) was employed in the collections. Examination of replicate samples collected with the different nets in three lakes showed no obvious bias in zooplankton abundance (expressed as individuals $/m^3$) or species composition related to net size.

Most lakes were sampled three to seven times (between May and October inclusive) over the three year course of the study; a few only once or twice. Linear regression of total species numbers data and the abundance of individual species against the number of sampling events for all lakes, and lakes grouped by pH intervals, showed poor correlation, suggesting that overall, the influence of variable sampling

Figure 1: Frequency distribution of selected characteristics within the study lakes.



frequency was small. Indeed, it should be noted that for most of the study lakes, sampling frequency was very similar (i.e.: 85% of the lakes were sampled 4 to 6 times). Immediately after collection, zooplankton were preserved in 10% formalin and samples were retained for subsequent examination. Identification and enumeration were carried out by Dr. W. T. Geiling, Limnoservices. A description of precedures used is provided in Yan and Strus (1979).

Prior to sample analysis, budgetary constraints necessitated the combination of individual collections for each lake in order to reduce the total number of samples. The compositing of several collections, representing a large volume of water, concentrates many plankters in one sample, necessitating the use of small subsamples for actual examination. Because of this procedure, less abundant taxa may not always be accurately represented and it is possible that some rare species were entirely overlooked. Additional potential problems stem from the sampling methodology employed. The nature of the sampling programme (only one location per lake and relatively few sampling dates) does not adequately consider spatial and temporal variations in zooplankton communities which may be large; however, synoptic surveys have provided much useful information on zooplankton communities (Patalas 1971; Sprules 1975). Also, sampling by net introduces other potential errors associated with avoidance by some species and may underestimate true abundance. Despite these limitations the present data base should prove useful from the viewpoint of general species distribution and relative abundance in a large, variable group of Ontario lakes.

RESULTS AND DISCUSSION

GENERAL OBSERVATIONS

The results of the identification and enumeration of crustacean zooplankton from the study lakes are summarized in Appendix A.

A total of 40 species (25 genera) of Crustacea, including 23 representatives of Cladocera and 17 species of Copepoda were collected from the study lakes. Among the copepods, 8 calanoid and 9 cyclopoid forms were found. Copepod nauplii and copepodids were numerically prominent in samples from most lakes however discussion is limited to data for adults. Twenty-two and 20 species respectively from the present study were common to crustacean plankton collections in regional lake studies in Northwestern Ontario (Patalas 1971) and the Killarney, Ontario area (Sprules 1975).

Bosmina longirostris[a] and Diaptomus minutus were the most frequently occurring species, found in over 90% of the lakes, with Diaphanosoma leuchtenbergianum, Holopedium gibberum, and Mesocyclops edax slightly less common occurring in 75 to 85% of the lakes. Species present in 50 to 75% of the lakes included Daphnia galeata mendotae, Daphnia longiremis, Daphnia retrocurva, Diaptomus oregonensis, Cyclops bicuspidatus thomasi, Cyclops scutifer, and Tropocyclops prasinus mexicanus while Eubosmina tubicen and Epischura lacustris were collected from 25 to 50%. Ceriodaphnia lacustris, Chydorus sphaericus, Daphnia ambigua, Daphnia catawba, Daphnia dubia, Daphnia pulex, Leptodora kindtii, Polyphemus pediculus, and Diaptomus sicilis

[a] may include Eubosmina longispina; see Erratum

were present in 10 to 25% of the study lakes while the remaining zooplankton species collected were comparatively rare, occurring in < 10%. These infrequently occurring Crustacea (some not truly planktonic), many of which were found in only one or two lakes, included *Alona guttata*, *Alona quadrangularis*, *Ceriodaphnia pulchella*, *Eurycercus lamellatus*, *Ilyocryptus spinifer*, *Latona setifira*, *Ophryoxus gracilis*, *Sida crystallina*, *Diaptomus ashlandi*, *Diaptomus sanguineus*, *Diaptomus siciloides*, *Limnocalanus macrurus*, *Ergasilus* sp., *Eucyclops speratus*, *Orthocyclops modestus*, *Cyclops vernalis* and *Paracyclops fimbriatus*.

Within individual lakes, the total number of species collected varied from 3 to 17 with an overall mean of 10.6 species per lake. The distribution of species numbers within the study lakes is provided in Figure 2. As shown in Figure 2 the most often encountered number of species per lake was 9 to 13.

Of the 40 zooplankton species found, 24 occurred as "dominants" (> 10% of the total sample; after Patalas 1971). It is important to note that due to sample treatment (i.e. combination of samples from various dates) the use of "dominance" in this report is incorrect in the ecological context of a numerically superior population within a community at a point in time. The term does however prove useful, within the bounds of the sampling limitations indicated, in outlining the relative importance of species in the study lakes. Generally, with some exceptions, the distribution of dominant species was similar to species occurrence i.e. the most frequently occurring species were the most common dominants. From 1 to 6 dominants per lake (mean 3.1) were found. As shown in Figure 3 the most prevalent case was 2 to 4 dominants per lake.

Figure 2: Frequency distribution of the number of crustacean plankton species within the study lakes.

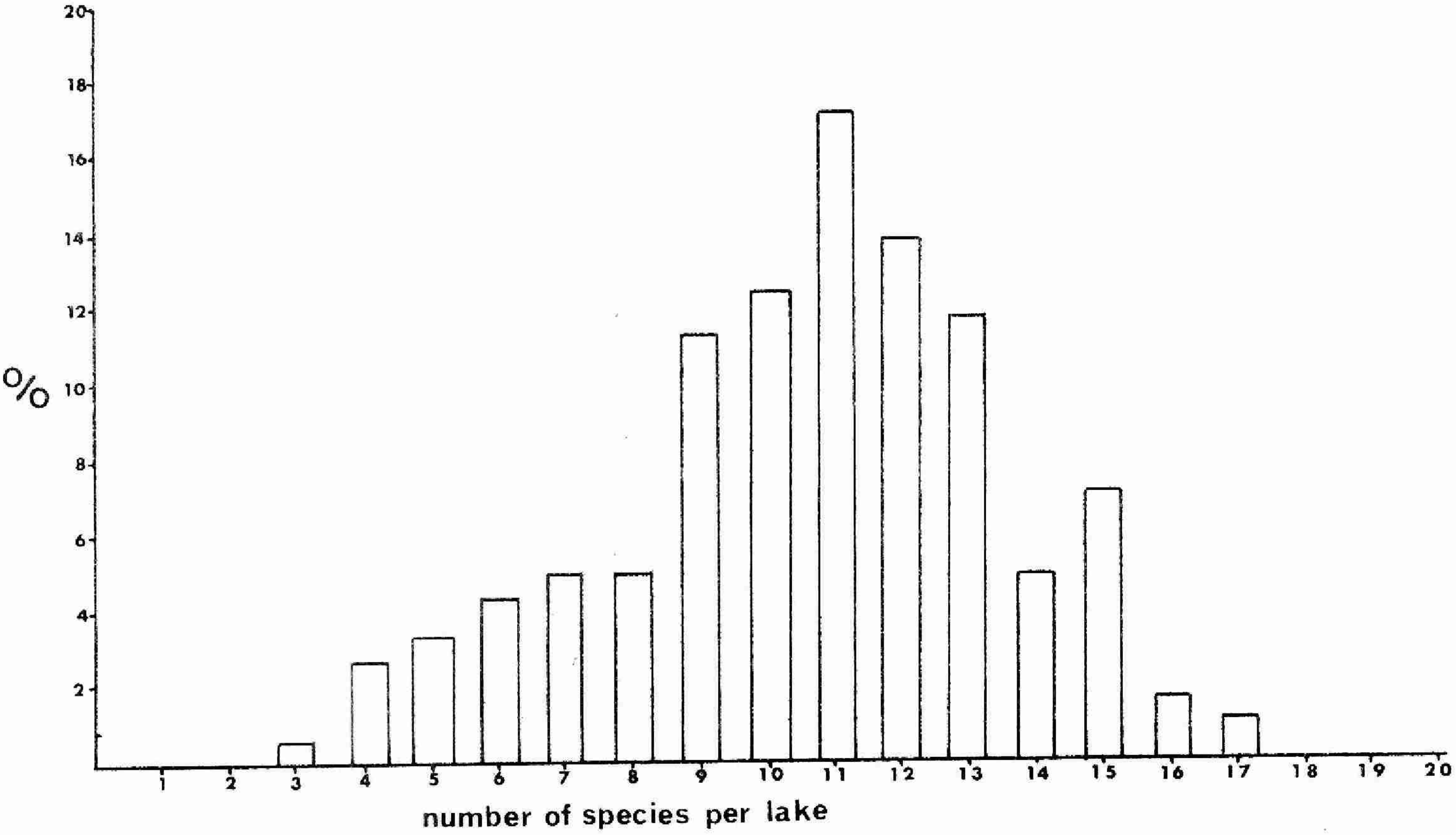
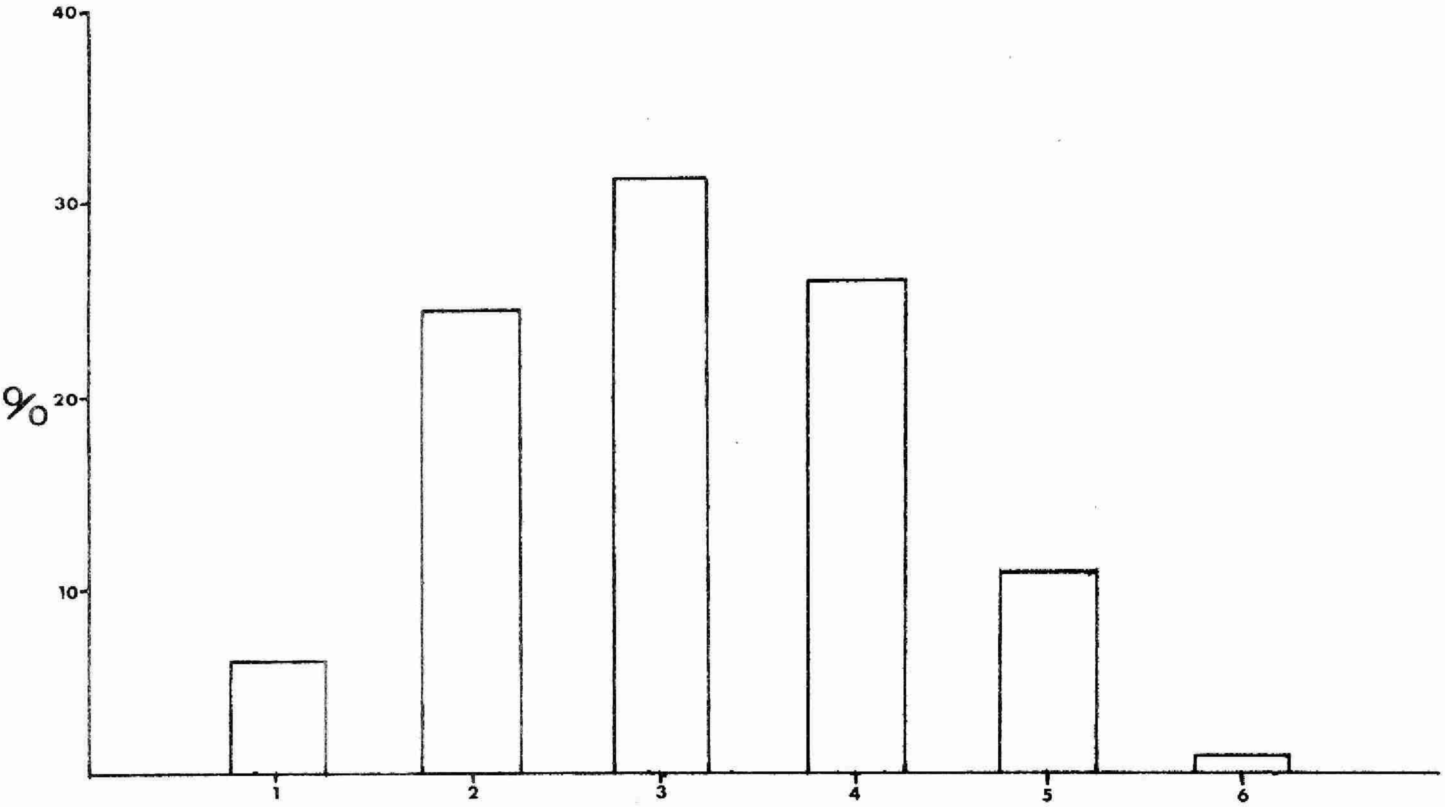


Figure 3: Frequency distribution of the number of dominant crustacean plankton species within the study lakes.



ENVIRONMENTAL INFLUENCES

Study of 45 unpolluted lakes in the Experimental Lakes Area of Northwestern Ontario (Patalas 1971) indicated that lake morphometry and transparency were the major determinants of the zooplankton communities in these systems. Sprules (1975) in a survey of 47 Killarney area lakes, many of which are acidified ($pH < 5$), apparently due to acidic atmospheric inputs (Beamish and Harvey 1972), found pH to be the major factor affecting the community structure and species abundance of crustacean zooplankton with lake area and depth assuming secondary importance. Linear regression analyses (Table I) of data from the present study showed a significant positive correlation ($p < 0.01$) between the number of zooplankton species per lake and pH ($r= 0.495$) indicating a similar pH effect. Some overlap exists between the lakes sampled during the present study and those studied by Sprules (1975).

Secchi disc transparency showed a significant ($p < 0.01$) negative correlation with number of species ($r= -0.508$) based on the present data, however, evaluation of the overall influence of transparency on species numbers is complicated by the overriding effect of pH, since the clearest lakes (connoting a low supply of solutes) are typically those predisposed to acidification. With lakes of $pH < 6.0$ excluded, a linear regression of species numbers against Secchi disc transparency was not significant ($r = -0.132$; $p > 0.1$). Further, examination of a subset ($n = 10$) of lakes with similar transparency (7 - 9 m) showed that the non-acidic (pH 5.7 - 7.1; $n = 5$) lakes had much greater

Table 1. Correlation coefficients (r) for significant ($p < 0.01$) linear regressions between the number of crustacean plankton species and environmental variables.

Variable [a]	r
Secchi disc (m)	-0.5080
pH	0.4950
Total Kjeldahl Nitrogen (μg/L)	0.3702
SO_4 (mg/L)	-0.3374
NO_2 (μg/L)	0.3070
Nickel (μg/L)	-0.2849
Zinc (μg/L)	-0.2636
Total Phosphorus (μg/L)	0.2543
Chlorophyll *a* (μg/L)	0.2451
Area (ha)	0.1845

[a] Variables examined which did not show significant ($p < 0.01$) relationships with species richness included sampling depth, conductivity, alkalinity, Ca, Mg, Na, K, NH_3, NO_3, Cu, Fe, Pb, Cl and SiO_2.

species richness ($\bar{x}$ 11.2 species/lake) than the acidic (pH < 5; n = 5) lakes ($\bar{x}$ 5.0 species/lake). This suggests low pH, rather than transparency, as the major cause of low zooplankton diversity in some very clear study lakes.

Although lake morphometry appears important in determining the distribution and relative abundance of some zooplankton species within the study area (see Appendix B), linear correlations between number of species and lake area and depth were poor (although significant, $p < 0.01$, for area). In addition to the complicating factor of variable pH, the poor correlation between species numbers and morphometry may be partly attributable to the bias of the present study toward larger (usually deeper) lakes accessible by float-equipped aircraft. Many of the morphometry controlled shifts in community structure and abundance suggested by Patalas (1971) occurred in groups of lakes characteristically much smaller than any sampled during this study.

Zooplankton species richness generally showed positive correlations with nitrogen, phosphorus and chlorophyll a concentrations ($r = 0.245$ to 0.370; $p < 0.01$) and negative correlations with nickel, zinc and sulphate concentrations ($r = -0.264$ to -0.337; $p < 0.01$). Additional work with cross-correlations between evironmental variables would be required to adequately define the true influence of these factors on zooplankton diversity.

Table 2 provides a summary of zooplankton species abundance within the study lakes as a function of mean pH. A significant decline in the number of zooplankton species per lake with decreasing pH is evident. Yan et al. (1977) have suggested that zooplankton communities in Precambrian Shield lakes remain unaffected to at least pH 5.7 and Sprules (1975) has indicated that the influence of low pH on crustacean plankton communities occurs primarily below pH 5.0. Data from the present study are in essential agreement with the results of these investigations, exhibiting a marked reduction in species numbers in lakes with pH < 5.0 (mean # species / lake 5.3 - 6.6, based on pH groupings from Table 2) in comparison to lakes with pH $\geq$ 5.0 (mean # species / lake 9.3 - 11.7). Interestingly, lakes of mean pH between 5.0 and 5.9 showed slightly lower numbers of species (mean # species / lake 9.3 - 10.1) than lakes of pH $\geq$ 6.0 (mean # species / lake 10.5 - 11.7).

Zooplankton species numbers in a survey of 57 Norwegian lakes (Leivestadt et al. 1976) demonstrated a similar pattern of pH dependency. Dillon et al. (1977) reported 2.5 to 3.8 species per collection for four acidified lakes (pH < 5.0) in the immediate vicinity of Sudbury, Ontario while Patalas (1971) found 4 to 14 species per lake in single collections from near-neutral Northwestern Ontario lakes. Species numbers data from the present investigation are not directly comparable to the above studies since the present results are based on combined samples representing several samplings. Comparison of results from 6 of the present study lakes for which single collections were available indicated combined sample results to be up to 60% higher than species numbers in single samples.

Table 2. Crustacean species abundance and numbers of dominant species in the study lakes as a function of pH.

$\bar{x}$ pH	Number of Species			Number of Dominants			Number of Lakes
	Total	Range/Lake	$\bar{x}$ / Lake	Total	Range/Lake	$\bar{x}$ / Lake	
4.0-4.4	12	4-6	5.3	3	1-2	1.3	4
4.5-4.9	23 (20[a])	3-17 (11[a])	6.6 (5.9[a])	7 (6[a])	1-5 (3[a])	2.3	17
5.0-5.4	19	7-13	9.3	9	2-4	3.3	12
5.5-5.9	23	6-16	10.1	11	2-4	3.1	16
6.0-6.4	26	7-15	10.9	14	1-5	3.0	24
6.5-6.9	32	5-16	11.7	17	1-5	3.4	61
7.0-7.4	29	7-17	11.7	13	1-6	3.2	36
7.5-7.9	24	7-15	10.5	12	2-5	3.5	11
8.0-8.4	21	8-14	11.2	7	1-4	2.7	6

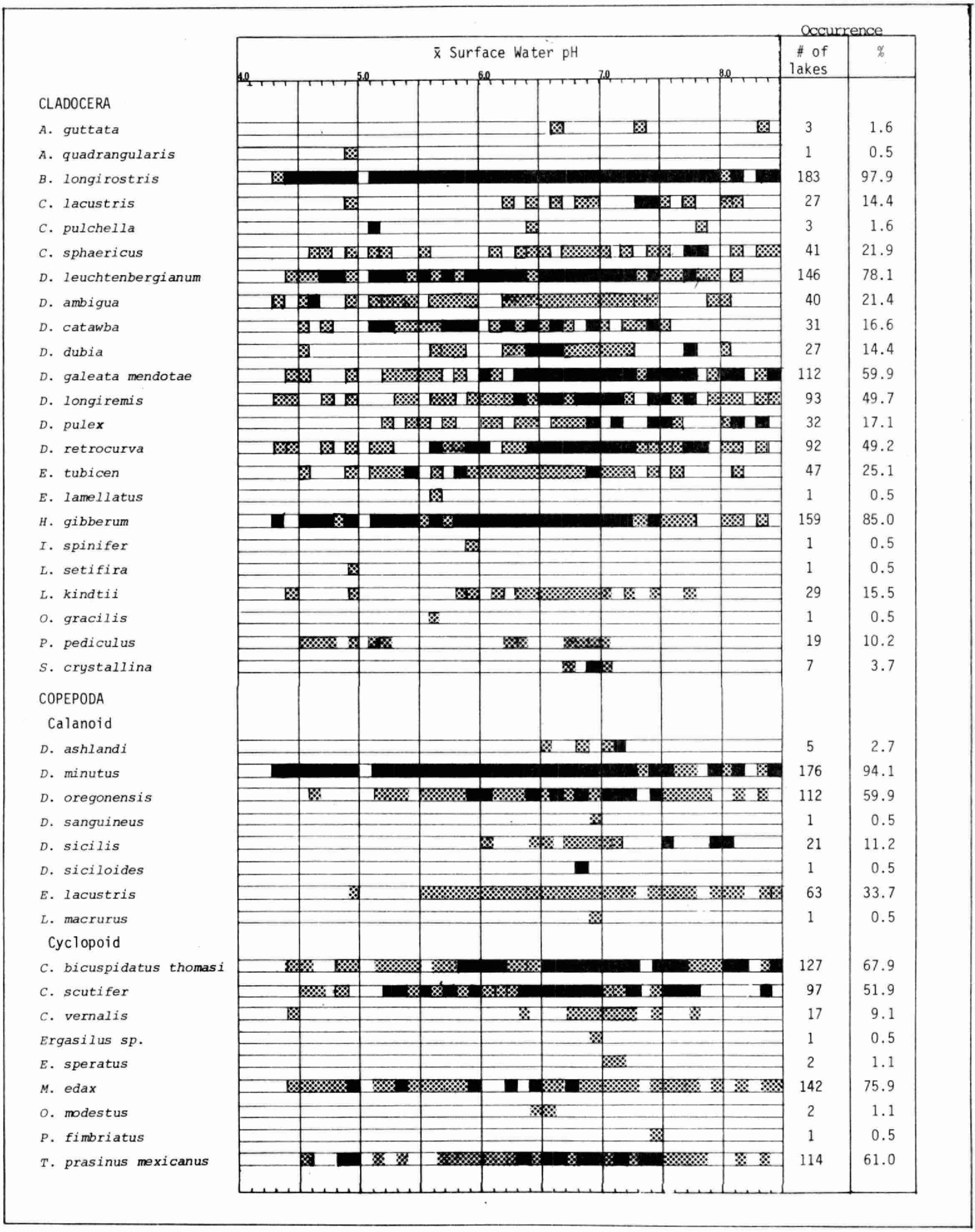
[a] excluding data for Round Lake (#40).

It is interesting to note that not all acidified lakes show a poor representation of zooplankton species. Round Lake (pH 4.9) contained 17 species of Crustacea (the maximum recorded during this study) despite its low pH. Two species (A. quadrangularis and L. setifera) were found only in this lake, and elimination of the Round Lake results substantially alters the summary of species numbers data for lakes of pH 4.5 to 4.9 as shown in Table 2. The cause of the unexpected diversity of zooplankton in this lake remains unexplained at present.

Figure 4 depicts the occurrence and dominance of individual species as a function of pH. Even though species diversity appears restricted in acidic lakes, most of the more common crustacean zooplankters were widely distributed across the pH range. Of the 23 species present in > 10% of the study lakes, 21 occurred (albeit often rarely) in lakes with pH < 5. This observation suggests that factors such as altered predation relationships rather than simply pH toxicity, may be largely responsible for the low zooplankton diversity in acidic lakes.

Although most species appear able to continue at least a limited existence at low pH, significant changes in relative abundance are evident from Figure 4. For example, Daphnia species, although reasonably widespread with regard to pH, generally did not occur as dominants (with some exceptions) at pH < 6.0 while B. longirostris, H. gibberum and D. minutus were consistently dominant throughout the pH range, constituting the only dominants in lakes with pH < 4.5. Lakes of pH < 5 generally contained only 1 or 2 dominants while lakes of pH > 5 usually had 3 to 4 dominants.

Figure 4: Ranges of occurrence and dominance of crustacean plankton species as related to pH.



	# of lakes	%
CLADOCERA		
A. guttata	3	1.6
A. quadrangularis	1	0.5
B. longirostris	183	97.9
C. lacustris	27	14.4
C. pulchella	3	1.6
C. sphaericus	41	21.9
D. leuchtenbergianum	146	78.1
D. ambigua	40	21.4
D. catawba	31	16.6
D. dubia	27	14.4
D. galeata mendotae	112	59.9
D. longiremis	93	49.7
D. pulex	32	17.1
D. retrocurva	92	49.2
E. tubicen	47	25.1
E. lamellatus	1	0.5
H. gibberum	159	85.0
I. spinifer	1	0.5
L. setifira	1	0.5
L. kindtii	29	15.5
O. gracilis	1	0.5
P. pediculus	19	10.2
S. crystallina	7	3.7
COPEPODA		
Calanoid		
D. ashlandi	5	2.7
D. minutus	176	94.1
D. oregonensis	112	59.9
D. sanguineus	1	0.5
D. sicilis	21	11.2
D. siciloides	1	0.5
E. lacustris	63	33.7
L. macrurus	1	0.5
Cyclopoid		
C. bicuspidatus thomasi	127	67.9
C. scutifer	97	51.9
C. vernalis	17	9.1
Ergasilus sp.	1	0.5
E. speratus	2	1.1
M. edax	142	75.9
O. modestus	2	1.1
P. fimbriatus	1	0.5
T. prasinus mexicanus	114	61.0

Occurrence ▨
Dominance ■

Figure 5 further depicts the increasing specialization of zooplankton communities which accompanies acidification. From Figure 5, it is evident that the number of different zooplankton species attaining dominance within lake groups declines markedly with decreasing pH. Only 7 species occurred as dominants in lakes of pH < 5, while dominant populations of 23 different species were found in the remaining study lakes.

NOTES ON SPECIES' OCCURRENCE

CLADOCERA

Alona

The genus Alona was represented by two species (A. guttata, and A. quadrangularis) in the study lakes. A. guttata occurred in three lakes of pH 6.6-8.3, while A. quadrangularis was found in only one lake of pH 4.9. Neither species attained dominance. The single occurrence of A. quadrangularis may reflect sampling error (i.e.: accidental contact of the net with submerged macrophytes) since this species is normally associated with areas of weed growth (Pennak 1953, p.375; Ward and Whipple 1966, p.642) and may not be considered truly planktonic.

FIGURE 5

FREQUENCY OF OCCURRENCE — DOMINANT CRUSTACEA

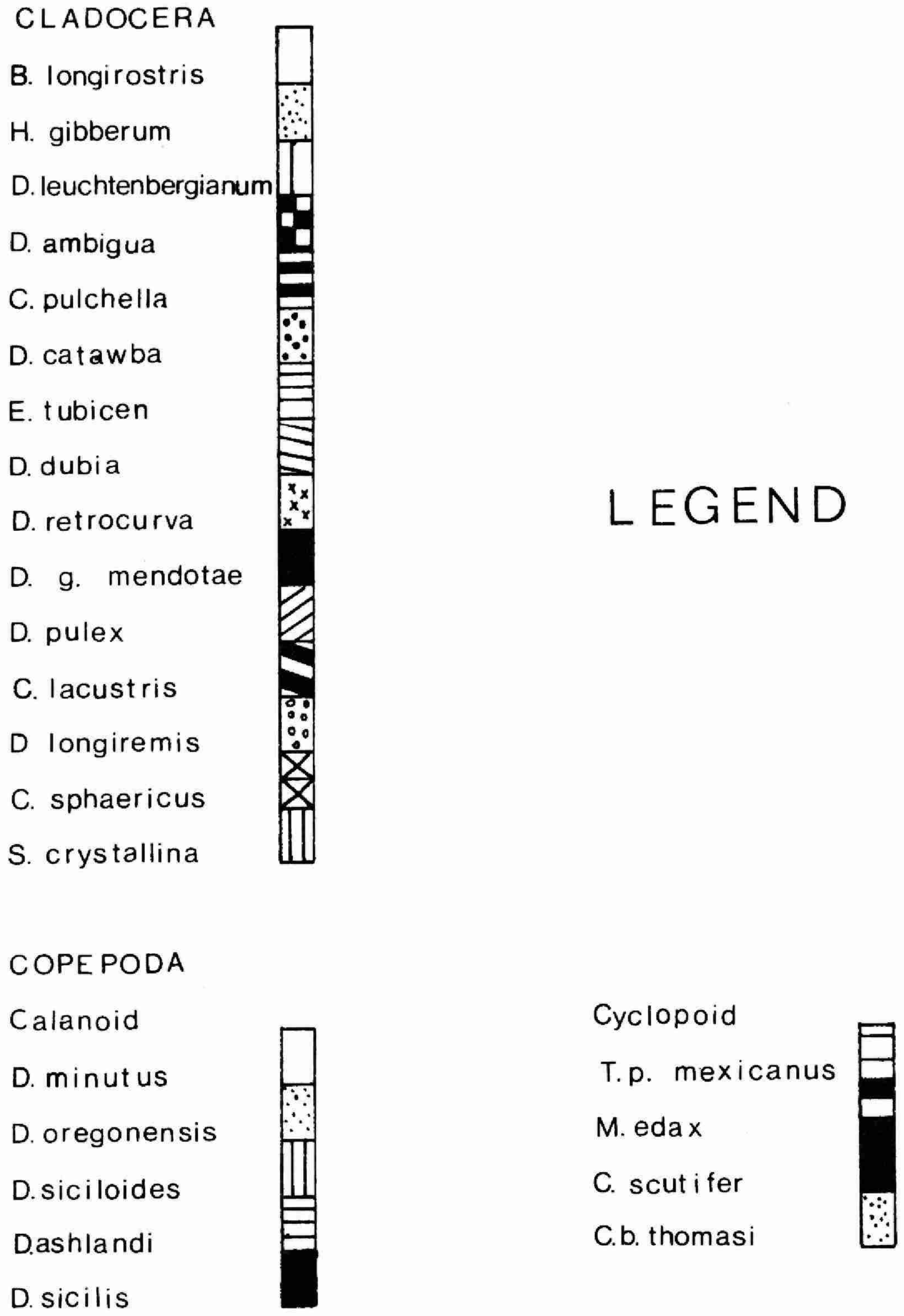


FIGURE 5a

FREQUENCY OF OCCURRENCE — DOMINANT CLADOCERANS

(HEIGHT OF THE VERTICAL BARS INDICATES THE PERCENT OF LAKES IN EACH pH INTERVAL IN WHICH THE SPECIES OCCURRED AS A DOMINANT)

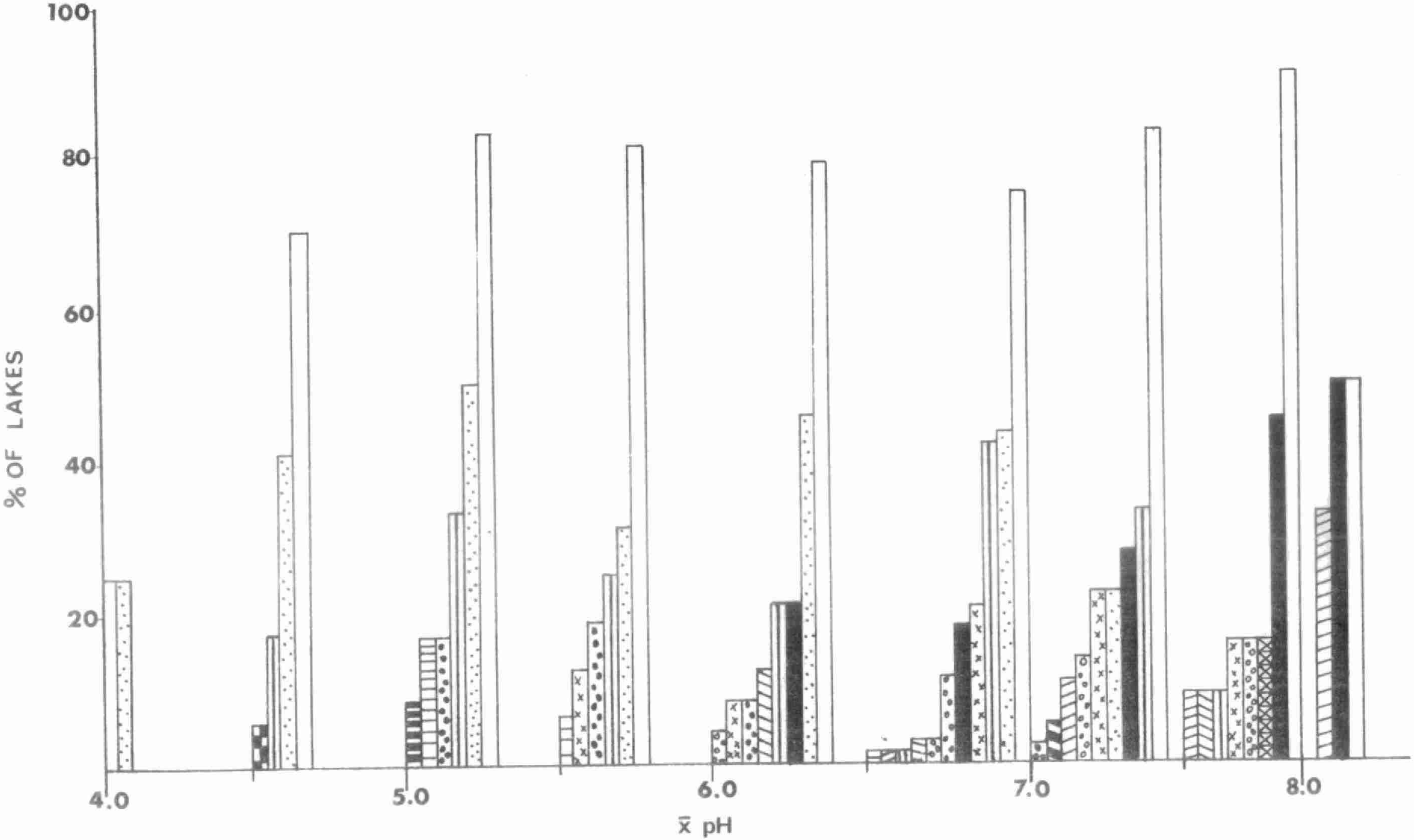


FIGURE 5b

FREQUENCY OF OCCURRENCE – DOMINANT CYCLOPOID COPEPODS

(HEIGHT OF THE VERTICAL BARS INDICATES THE PERCENT OF LAKES IN EACH pH INTERVAL IN WHICH THE SPECIES OCCURRED AS A DOMINANT)

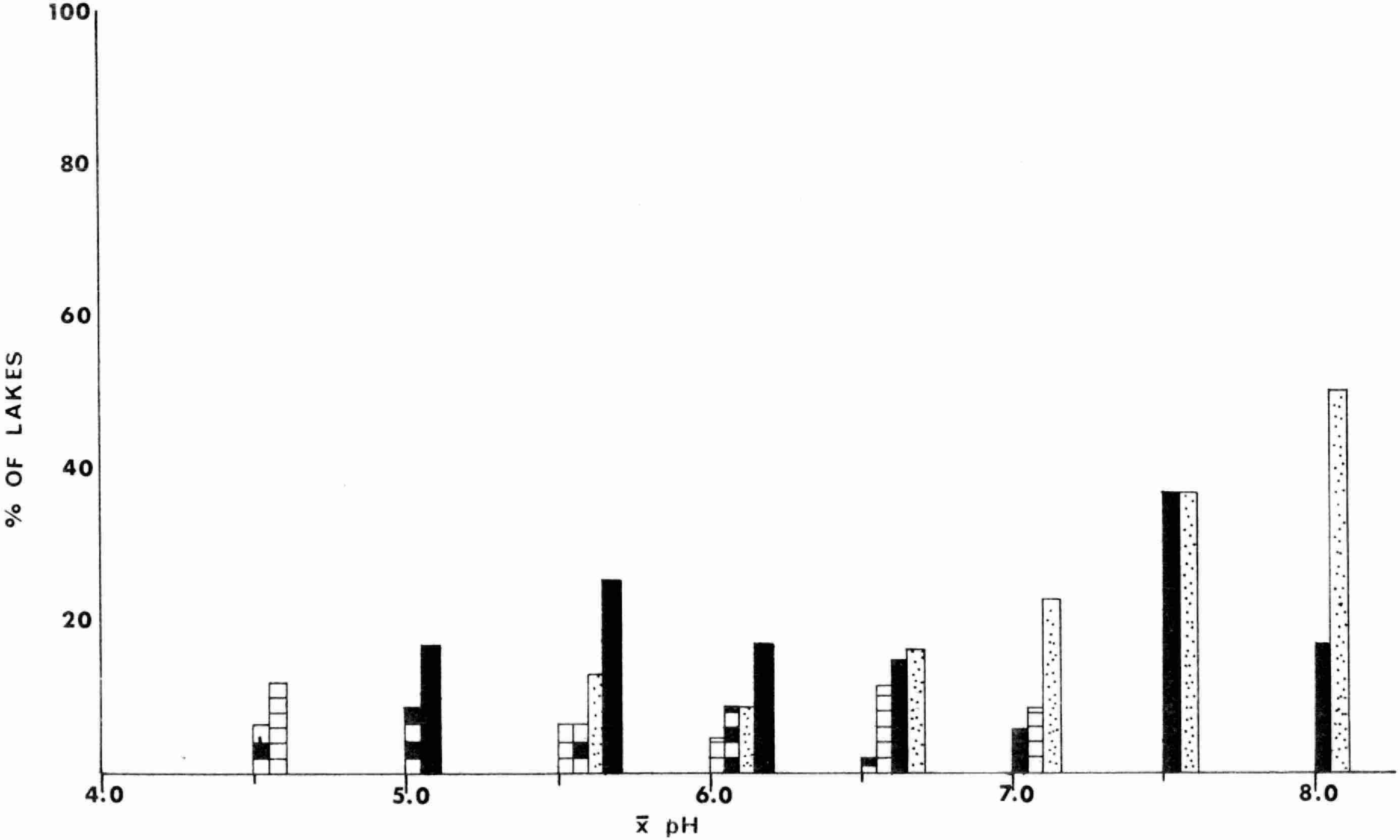
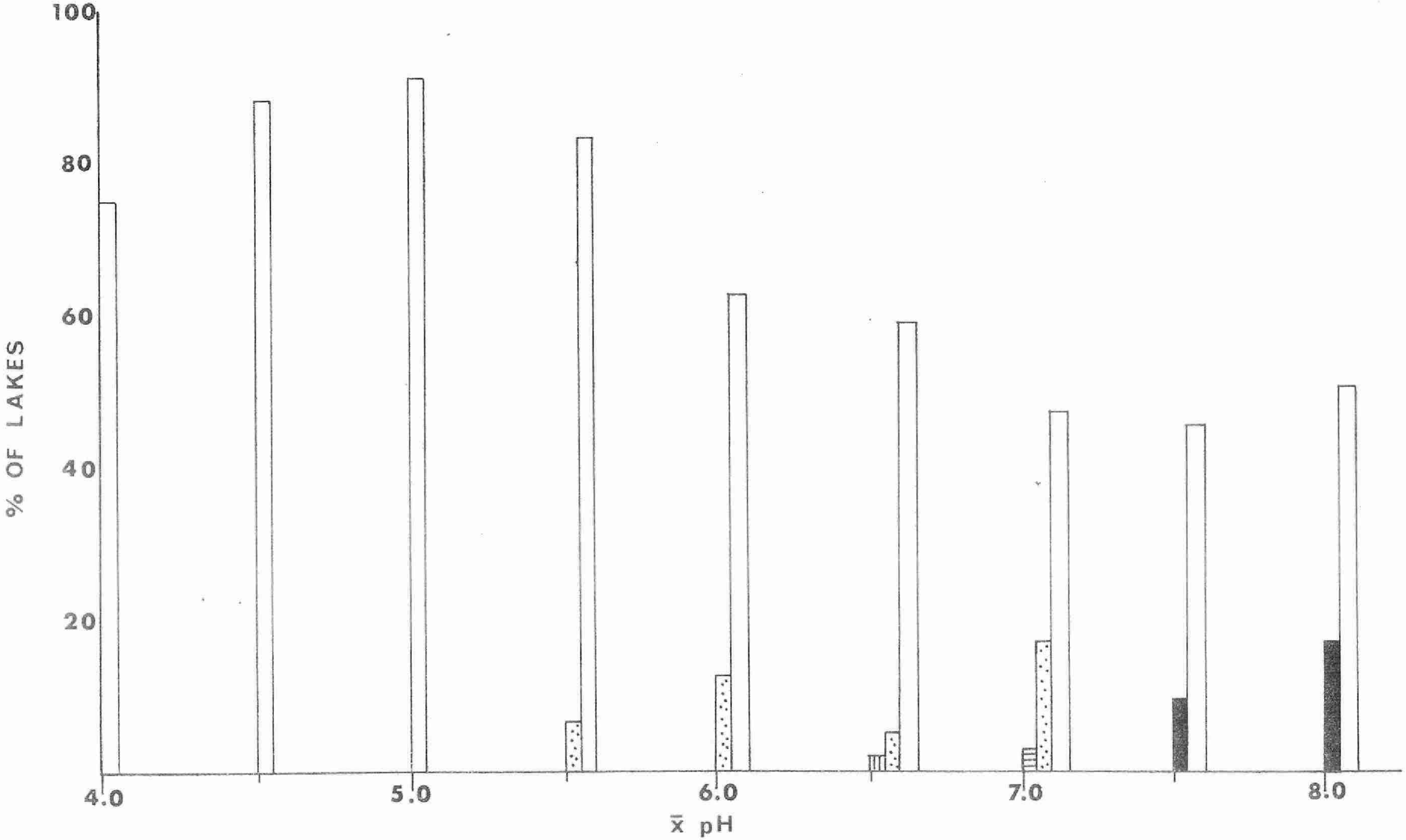


FIGURE 5c

FREQUENCY OF OCCURRENCE – DOMINANT CALANOID COPEPODS

(HEIGHT OF THE VERTICAL BARS INDICATES THE PERCENT OF LAKES IN EACH pH INTERVAL IN WHICH THE SPECIES OCCURRED AS A DOMINANT)



Bosmina[a]

A single representative of this genus, B. longirostris, was the most common (present in 97.9%; dominant in 77.5%) crustacean zooplankter in the study lakes, consistent with its' widespread, ubiquitous nature (Pennak 1953, p.370; Ward and Whipple 1966, p. 625). B. longirostris, previously documented as a common acid lake dominant (Sprules 1975; Dillon et al. 1977), occurred as a dominant throughout the range of pH, transparency and morphometry found within lakes of the study area.

Ceriodaphnia

Two species of Ceriodaphnia (C. lacustris and C. pulchella) were collected. Only C. lacustris assumed some importance (present in 14.4% of the study lakes). A slight preference toward shallower lakes of higher pH and low to moderate transparency was indicated for C. lacustris. C. pulchella occurred only in three lakes, ranging widely in pH (5.1-7.8). C. pulchella has also been reported as rare in lakes of the Experimental Lakes Area, Northwestern Ontario (Patalas 1971).

Chydorus

C. sphaericus, the only representative of this genus collected, occurred in 21.9% of the study lakes which exhibited a wide range in pH (4.6-8.4). C. sphaericus generally showed greater numerical importance (although rarely reaching dominance) and a higher frequency of occurrence in lakes of shallow to medium depth, low to moderate transparency and near-neutral pH, although the species has been reported as important in acid lakes (Scheider et al. 1975).

[a] see Erratum

Diaphanosoma

D. leuchtenbergianum, the only species of Diaphanosoma found in the study lakes, occurred and dominated (78.1% and 29.4% of the lakes respectively) over a wide range in pH (4.4-8.1). Although some preference toward lakes of low to medium transparency and intermediate pH is suggested, the data support previous studies (Carter 1971; Patalas 1971; Sprules 1975) which indicate adaptability to a wide variety of chemical and physical conditions.

Daphnia

The genus Daphnia was represented by seven species showing variable environmental preferences.

D. g. mendotae, the most common daphnid (present in 59.9% of the lakes), occurred over most of the range in pH, transparency and morphometry, although relative importance (frequency of dominance) was typically greatest in the larger, more transparent lakes of pH $\geq$ 6.0. Similar observations have been made by Patalas (1971) in lakes of northwestern Ontario. D. longiremis, slightly less common (49.7% of the lakes) exhibited a somewhat similar distribution. D. retrocurva also demonstrated a pattern of increasing importance in lakes of intermediate to higher pH (> 5.5) however a strong bias toward shallow lakes of low transparency was also apparent.

D. ambigua was present in 21.4% of the study lakes, but rarely (only one lake) as a dominant. Patterns of environmental control were not evident, however, it was noted that D. ambigua reached dominance only in a highly transparent (Secchi disc > 9m), acidic (pH < 5) lake. D. ambigua has been documented as the predominant cladoceran in four very acid ponds near Georgian Bay (Carter 1971), although Sprules (1975) did not find this species in LaCloche Mountain lakes with pH < 5.0.

Although reported as absent (Carter 1971; Sprules 1975) or uncommon (Patalas 1971) in other regional lake and pond studies in Ontario, D. pulex was reasonably common in the study lakes (17.1%). D. pulex did not occur in lakes with pH $\leq$ 5.0 and never dominated in lakes of pH < 6.9.

D. catawba, found in 16.6% of the lakes, was most common and abundant in lakes of intermediate pH (5.0-6.5), high transparency (> 6m) and small to medium size (< 400 ha). D. dubia was present over a wide range of pH, morphometry and transparency, however, populations only attained dominance in lakes of pH $\geq$ 6.4.

Generally, based on observations of relative abundance and range of occurence, the data suggests an order of increasing sensitivity to low pH such as D. ambigua < D. catawba < D. retrocurva < D. g. mendotae $\leq$ D. longiremis $\leq$ D. dubia < D. pulex.

Eubosmina[a]

This genus was represented only by E. tubicen which was present in 25.1% of the lakes (dominant in 2.1%). E. tubicen occurred in lakes ranging widely in pH, transparency and morphometry, however the importance of the species appeared greatest in lakes of pH 5.0-5.9.

Eurycercus

Found in only one lake (pH 5.6), E. lamellatus, considered a littoral species (Ward and Whipple 1966, p.634), may have largely escaped detection in the study lakes due to the emphasis toward sampling of open water environments.

Holopedium

The common, widespread (Pennak 1953, p.365; Ward and Whipple 1966, p.603) species H. gibberum was the second most frequently occurring cladoceran (85%) in the study lakes. H. gibberum was present, and occurred as a dominant in lakes of all types, but was conspicuously absent as a dominant form in lakes of pH > 7.5.

Ilyocryptus

I. spinifer was present in only one lake of pH 5.9, area 242 ha and Secchi disc 4.6m.

[a] see Erratum

Latona

The collection of L. setifera in one lake (pH 4.9; area 230 ha; Secchi disc 4.4m) appears to be accidental since this species is normally found among littoral vegetation (Pennak 1953, p.365; Ward and Whipple 1966 p.600).

Leptodora

The single species collected (L. kindtii), occurred in lakes (15.5%) of many types, covering a wide range in pH, however populations never reached dominance. Similar results indicating generally low abundance, were obtained from synoptic studies of ponds near Georgian Bay (Carter 1971) and lakes in northwestern Ontario (Patalas 1971).

Ophryoxus

O. gracilis, generally associated with aquatic macrophytes (Pennak 1953, p.370; Ward and Whipple 1966, p.626), was collected in a single 316 ha lake of pH 5.6.

Polyphemus

A single representative of this genus, P. pediculus was present in 10.2% of the study lakes. No relationship to transparency or morphometry was apparent, however the most frequent occurrence of P. pediculus was noted in lakes of pH < 5.5, supporting the observation of Sprules

(1975) that this species occurs primarily in lakes of low pH. Populations of *P. pediculus* did not attain dominance in any of the study lakes.

Sida

This genus was represented by a single species, *S. crystallina* which occurred in seven lakes of near-neutral pH.

CALANOIDA

Diaptomus

The study lakes contained six species of the genus *Diaptomus*. *D. minutus* was the most common and abundant copepod, occurring in 94.1% of the lakes (dominant in 63.1%). Although present, and numerically important in lakes of all types, *D. minutus* was most prominent in very clear, deep lakes of low pH (< 6.0). A similar preference for transparent water and deep lakes has been reported by Patalas (1971), and Sprules (1975) has indicated that *D. minutus* is the only zooplankton species which remains in some very acidic LaCloche Mountain lakes.

D. oregonensis was present in 59.9% of the lakes and existed as a a dominant in 7.0%. This species was most important in lakes of intermediate to high pH ($\geq$ 5.5) and low to moderate transparency.

D. sicilis (present in 11.2% and dominant in 1.6% of the lakes) occurred only in lakes of pH ≥ 6.0, and dominant populations were found only at pH ≥ 7.5. The remaining diaptomids, D. ashlandi, D. sanguineus and D. siciloides were rare in the study lakes (five, one and one lake(s) respectively) and were restricted to waters with pH > 6.5.

Epischura

This genus was represented by one species, E. lacustris which occurred in 33.7% of the lakes but never reached dominant status. With the exception of a limited occurrence (one lake) at pH < 5, E. lacustris was restricted to lakes of intermediate to high pH (≥ 5.5).

Limnocalanus

L. macrurus was collected from only one lake (309 ha) of pH 6.9 with a Secchi disc transparency of 4.6m.

CYLOPOIDA

Cyclops

Three species of this genus (C. b. thomasi, C. scutifer and C. vernalis) were found. C. b. thomasi was most important, present in 67.9% of the lakes and occurring as a dominant in 16.6%. Although present in all lake types, C. b. thomasi showed an increasing frequency of occurrence, and dominance, in lakes of pH > 5.5.

C. scutifer, slightly less common (51.9% of the lakes) was also widely distributed among lake types and did not occur as a dominant at pH < 5.0. *C. vernalis*, less common (9.1%), never occurred as a dominant. It is interesting to note that the greatest frequency of occurrence of *C. vernalis* was found among lakes of pH < 4.5 while it was absent from all other lakes of pH < 6.3.

Ergasilus

Ergasilus sp. was found in only one lake (pH 6.9; area 56 ha; Secchi disc 3.3m).

Eucyclops

E. speratus occurred in two lakes (pH 7.0-7.1; area 73-2423 ha; Secchi disc 3.7-6.0m).

Mesocyclops

M. edax, the only species of *Mesocyclops* found, was commonly present (75.9%) in the study lakes over a wide range of pH, transparency and morphometry. Dominant populations of *M. edax* (3.2% of the lakes) were generally associated with lakes of low to intermediate pH and medium transparency.

Orthocyclops

O. modestus the only species of the genus collected, occurred in two lakes (pH 6.5-6.6; area 71-131 ha; Secchi disc 2.8-3.6m).

Paracyclops

A single species, P. fimbriatus, was collected from one lake (pH 7.4; area 514 ha; Secchi disc 3.2m).

Tropocyclops

T. p. mexicanus was a common cyclopoid form in the study lakes (61.0%). Dominant populations were found in two lakes of pH < 5, however, T. p. mexicanus was most strongly associated with lakes of intermediate to high pH (> 5.5), low to moderate transparency, shallow depth, and small to medium size. These results are consistent with previous observations on the environmental preferences of T. p. mexicanus (Patalas 1971).

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K. Hawley, S. Dingwall, R. Langlois, B. Ranta and D. Willis carried out the sample collections. J. Gullick, N. Keller, J. Linquist and M. Taylor assisted in the compilation and preparation of data. S. Sloan typed and corrected the manuscript.

ERRATUM

After finalization of this report a potential taxonomic discrepancy came to light. Reference to *Bosmina longirostris* in this report may also include *Eubosmina longispina*. Samples are being re-examined for the presence of *E. longispina*.

Re-examination indicated that *Bosmina longirostris* was present in 94% of the samples and *Eubosmina longispina* occurred in 39%. Where both species co-occurred, *B. longirostris* was numerically more important in 53% of the samples while *E. longispina* was more abundant in 47%. Occurrence and abundance of *E. longispina* showed no obvious associations with lake type.

APPENDIX A

Summarized results of the identification and enumeration of crustacean zooplankton from the study lakes. Presence is denoted by open circles (o), dominance by closed circles (●). Lake identification numbers are provided to permit lake location on Map #1. Relative abundance was evaluated on the basis of animals /m^3.

SPECIES	LAKES																																			
	Nelson (1)	Windy (2)	Whitewater (3)	Fairbank (4)	Frenchman (5)	Skill (6)	Little Panache (7)	Reef (8)	Gabodin (9)	Wavy (10)	Long (11)	Whitefish (12)	Clearwater (13)	Millerd (14)	Nepewassi (15)	Raft (16)	McFarlane (17)	Whitson (18)	Capreol (19)	Onaping (20)	Geneva (21)	McCauley (22)	Bluewater (23)	Shakwa (24)	Pogamasing (25)	Mozhabong (26)	Richardson (27)	Schist (28)	Cavell (29)	Lac aux Sables (30)	Bark (31)	Low Water (32)	Nipissing (33)	Trout (34)	Lower Sturgeon (35	Ham (36)
CLADOCERA																																				
Alona guttata																																				
A. quadrangularis																																				
Bosmina longirostris	●	●	●	●	●	●	○	●	●	●	●	●	●	●	○	●	●	○	●	●	○	●	●	●	●	●	○	○	●	●	●	●	●	●	●	●
Ceriodaphnia lacustris									○												○							○	○							
C. pulchella			○																																	
Chydorus sphaericus			●		○		○				○								○			○									○		○			
Diaphanosoma leuchtenbergianum		○	○	○	○	●			○	○	●	○		○	●	○	○	●	●		○	○	○	○	○	○		○	○	○	○	○	○	●	●	●
Daphnia ambigua						○	○													○												○		○		○
D. catawba																				○	○															
D. dubia							○																○			○				●						
D. galeata mendotae		○				○	●		○		○	○	○	○	●		●			○	●	●	○	○			○	●	○	○	○		○	○		
D. longiremis	○	○				○	○							○						○	○		○	●	●	○			○	○	○	○	○	○	○	○
D. pulex					○		○													○	○								●							
D. retrocurva			●	○		●	○		○		○	●		○	●		○						○	○	○			○		○	○	○	●	○		●
Eubosmina tubicen									○																					○			○	○		○
Eurycercus lamellatus	○																																			
Holopedium gibberum		●			○	○	○	○	●		○				●	○		○	●	●	●	○	●	●	●	●	●	●	●	○	●	●	○	○	○	○
Ilyocryptus spinifer																																				
Latona setifira																																				
Leptodora kindtii		○									○											○	○										○			
Ophryoxus gracilis	○																																			
Polyphemus pediculus									○																							○		○		
Sida crystallina																																				
COPEPODA																																				
Cyclops bicuspidatus thomasi	○	○	○	●		●	●	○			○	○	○	●		○	○		○	○	○		○		●	○		○		○	○		○	○	○	
C. scutifer	○	●							○							○			○	○	○		○	●	○	○		○		●	●			○	○	
C. vernalis													○									○											○	○	○	
Diaptomus ashlandi																																	○		○	
D. minutus	●	●		●	●	○	○	●	●	●	○	●	○	○	○	●	●	○	●	●	○	●	○	○	○	●	○	○		○	○	○	●	●	○	○
D. oregonensis		○	○		○	○					○	○		○	●		○		○		○		○		○	○	○	○	○	●	○	○	○	○	○	●
D. sanguineus																															○					
D. sicilis		○		○			●							○																	○			○	○	
D. siciloides																																				
Epischura lacustris		○					○					○									○	○				○	○					○	○			
Ergasilus sp.																																				
Eucyclops speratus																																				
Limnocalanus macrurus																																				
Mesocyclops edax	○	○	○	○		○		○	○		○		○	○	○	○	○		○	○	○	○	○	○	○			○		○	○	○	○		○	○
Orthocyclops modestus																																				
Paracyclops fimbriatus																																				
Tropocyclops prasinus mexicanus		○	○			○								○	○			●	○		○	○		○	○		○	○	○		○	○	○	○		○
# of Species	8	14	9	7	7	12	13	5	11	3	11	8	6	11	9	7	8	5	10	11	15	11	13	10	11	10	7	12	9	13	15	12	17	16	12	11
# of Dominants	2	4	3	3	2	4	3	2	3	2	2	3	1	2	5	2	3	2	4	3	2	3	2	4	4	3	1	2	3	4	3	2	3	3	2	4
# of Samples	6	6	6	6	6	6	5	5	6	7	7	7	6	6	7	7	5	5	6	6	6	6	6	6	5	6	5	6	5	6	5	5	6	7	6	6

SPECIES	LAKES																																			
	Kakakiwaganda (37)	Magnetawan R. (38)	Naiscoot (39)	Round (40)	Trout (42)	Island (43)	Cecebe (44)	Eagle (45)	Restoule (46)	Shawanaga (47)	Nepewassi (48)	Kukagami (49)	Chiniguchi (50)	Matagamasi (51)	Wanapitei (52)	Ashigami (53)	Laura (54)	Emerald (55)	Temagami (56)	Obabika (57)	Red Cedar (58)	Jumping Caribou (59)	Lady Evelyn (60	Diamond (61)	Lorraine (63)	Fanny (64)	Hammond (65)	Rib (66)	Yortson (67)	Bassoon (68)	Bear (69)	Threenarrows (70)	Nellie (71)	Elizabeth (72)	Loon (73)	Evangeline (74)
CLADOCERA																																				
Alona guttata																																				
A. quadrangularis				○																																
Bosmina longirostris	●	●	●	●	●	●	●	○	●	●	○	○	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	●	○	●	○	●	○	●	●	●
Ceriodaphnia lacustris			○				○	○	○										○						○											
C. pulchella										○																										
Chydorus sphaericus	○			○				○			○									○														○		
Diaphanosoma leuchtenbergianum	●	○	●	○	●	○	●		●	○	●			○	○	●			●	○	●	●	●	○	●	●	○	○	○	○	○	○		○	○	○
Daphnia ambigua				○		○						○	○			○	○				○														○	○
D. catawba			○				○	●									●				○						○		●			○				
D. dubia						○							○					○																		
D. galeata mendotae	○			○	●	○	○	○	○	○	○							○	○		○	●	○			○	●	○			○	○		○	○	○
D. longiremis	●			○	○			○			○	○				○		○		○	○	○			○					○	○		○		●	○
D. pulex											○																		○			○				
D. retrocurva	○	○	○		○	○	●		○	●	●								○	○	●				●				○		○		○		○	●
Eubosmina tubicen			○	○		●	○	●	○			○				○			○	○		○	○	○		○						●				
Eurycercus lamellatus																																				
Holopedium gibberum	○	○	●	●	○	○	●	○	○	●	●	●	●	●		●	○	○	●	○	○	○	●	●	○	●		○	○		●	●		○	○	○
Ilyocryptus spinifer																																				
Latona setifira				○																																
Leptodora kindtii				○		○												○					○								○					○
Ophryoxus gracilis																																				
Polyphemus pediculus								○									○		○	○																
Sida crystallina	○																																			
COPEPODA																																				
Cyclops bicuspidatus thomasi	○	○	○	○	●	●	○	○	○	○	○		○		○		○	○	●	○	○	○	○	○	●	○	●	○	○	●	●		○	●	●	○
C. scutifer	○	○	○	○		○	○			○	○	●			○	○	●	○			○	○		○	○			○	●		○	○			○	
C. vernalis	○								○																○						○					○
Diaptomus ashlandi																				○																
D. minutus	○	○	○	●	○	●	○	●	○	○		●	●	●	●	●	●	●	●	●	●	●	●	●	○	●	●	●	●	○	●	●	●	○	○	●
D. oregonensis	○	○	○			○	○		○		○				●		○	○	○		○	○			●			○	○	○	○				○	○
D. sanguineus																																				
D. sicilis																			○								○	○		●	○				○	
D. siciloides									●																											
Epischura lacustris			○	○	○	○		○	○	○	○					○			○			○	○			○	○	○	○							
Ergasilus sp.																																				
Eucyclops speratus																					○															
Limnocalanus macrurus																																				
Mesocyclops edax	○		○	●	○	○	○	○	○	○		○		○	○	○	○	○	○	○	○	○	○	○	○	○			○	○	○			○	○	○
Orthocyclops modestus																																				
Paracyclops fimbriatus																																				
Tropocyclops prasinus mexicanus	○	○	○	●	○	○	○	○	○	○	○					○			○	○	○	○	○	○	○	●	○	○	○	○				○	○	○
# of Species	15	9	14	17	11	16	14	14	15	12	12	8	6	5	7	11	10	11	15	13	15	13	11	9	13	10	9	11	13	9	14	9	5	9	14	14
# of Dominants	3	1	3	5	4	4	4	3	3	3	3	3	3	3	3	4	4	2	5	2	3	4	4	3	5	5	4	2	3	3	3	4	1	2	3	3
# of Samples	6	5	6	7	5	6	5	5	5	6	7	6	5	7	5	6	6	6	5	6	6	7	6	5	5	5	5	5	6	6	6	6	5	5	6	6

SPECIES	LAKES																																			
	Hele (75)	Panache (76)	Annie (77)	Lewis (78)	O.S.A. (79)	George (80)	Kagawong (81)	Manitou (82)	Margaret (83)	Bigwood (84)	Opikinimika (85)	Shoofly (86)	Barnet (87)	Welcome (88)	Marne (89)	Tatachikapika (90)	Stull (91)	Sunnywater (92)	Laundrie (93)	Florence (94)	Mountain (95)	Midlothian (96)	Jim Edwards (97)	Tenfish (98)	Flack (99)	East Bull (100)	Armstrong (101)	Totten (102)	Nosbonsing (103)	Talon (104)	Trout (105)	Timber (106)	Deer (107)	Ratter (108)	Tomiko (109)	McConnell (110)
CLADOCERA																																				
Alona guttata				○																																
A. quadrangularis																																				
Bosmina longirostris	●	●	●	●	○	●	●	●	○	●	●	○	○	●	●	○	●	○	●	○	●	●	●	●	○	●	○	○	●	●	●	●	●	●	●	○
Ceriodaphnia lacustris															○							○											○			
C. pulchella																																				
Chydorus sphaericus				○		○	○								○				○			○	○			○			○				●			
Diaphanosoma leuchtenbergianum		●	●		○	○		○	○	○	○		○	○	○	○	●	○	○		○	○			○	○			○	○	○	○	○	●	●	
Daphnia ambigua			○					○					○																							○
D. catawba									○	○									○								○									●
D. dubia																								○								○				
D. galeata mendotae	○	○		○	○	○	●	○	○		●		○			●					○	○		○	○	●	●	●	●			○			○	
D. longiremis	○			○			○	○			○	○	○	○	○	●			○		○	●				●			○	○		●				●
D. pulex						○					○	●	●	○	○									○												●
D. retrocurva		○		○		○			○		○	○		○	○		○	○	○			○		○					○	○	○		●	●	○	
Eubosmina tubicen			○		○	○					○				○		○				○														○	○
Eurycercus lamellatus																																				
Holopedium gibberum	○	○	●	○	○	●			●	○	○	○	●	○	○	○	●		●	○		○				●	●	○	○	○	●	●	○	●	●	●
Ilyocryptus spinifer																	○																			
Latona setifira																																				
Leptodora kindtii	○																				○											○				
Ophryoxus gracilis																																				
Polyphemus pediculus					○	○													○				○	○												
Sida crystallina									●															○												
COPEPODA																																				
Cyclops bicuspidatus thomasi	●	○			○	○	●	○	○	○	●	○		○	○	○	○				○	○			○	○	○	○		○	○			○	○	○
C. scutifer		○			○					○	●	●	●	○		○				○	○	●	○	●	●	○	●	●			○	●			○	○
C. vernalis																													○	○						
Diaptomus ashlandi																														●		○				
D. minutus	●	●	●	○	●	●	●	●	○	●	○	○	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	○	○	●	○	●			○	
D. oregonensis	○	○		○						○	○	○	○	○	○	○	○		○		○			○		○	○	○	○	○				○	○	○
D. sanguineus																																				
D. sicilis		○						●	○																						○					
D. siciloides																																				
Epischura lacustris	○	○		○			○	○		○	○	○				○	○				○					○	○		○	○					○	
Ergasilus sp.									○																											
Eucyclops speratus																																				
Limnocalanus macrurus																																				
Mesocyclops edax		○	○				○	○		○	○	○	○	○	○	○	○		○		○	○	○		○	○	○	○	○		○			○	○	○
Orthocyclops modestus																																				
Paracyclops fimbriatus																																				
Tropocyclops prasinus mexicanus	○	○	○	○	○				○	○	○	○	●	○	○		○				○	○			○	○		○	○	○			○	○		
# of Species	10	13	8	11	10	11	8	10	12	11	15	12	12	12	14	11	12	4	11	4	13	13	6	10	8	13	10	9	13	12	9	10	7	8	12	11
# of Dominants	3	3	4	1	1	3	4	3	2	2	4	2	5	2	2	3	4	1	3	1	1	4	2	3	2	5	4	2	2	3	2	5	3	4	3	4
# of Samples	5	5	6	5	6	5	5	5	5	6	5	5	5	4	4	4	5	6	4	4	4	4	5	6	6	6	6	5	4	5	3	5	5	6	7	6

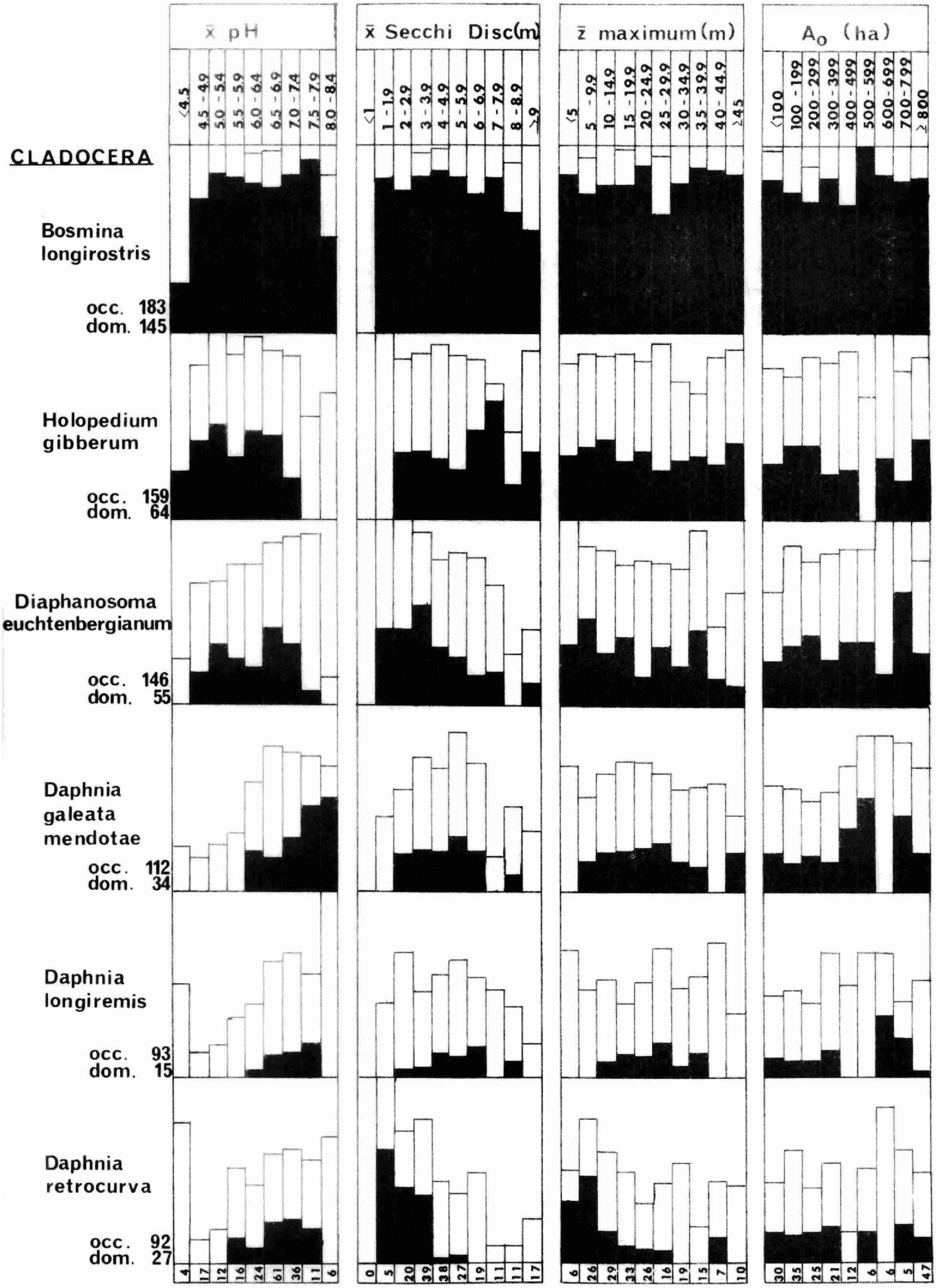
SPECIES	LAKES																																			
	Valin (111)	arten (112)	Tyson (113)	ell (114)	Bird (115)	Fraleck (117)	Telfer (118)	Maskinonge (119)	Murray (120)	Donald (121)	Mountain (122)	Frederick (123)	Onaping (124)	Obushkong (125)	Shack (126)	Makobe (127)	McKee (128)	Solace (129)	Alphretta (130)	Sam Martin (131)	Hutton (132)	Morrison (133)	Bigwind (134)	Leonard (135)	Nine Mile (136)	Skeleton (137)	Bass (138)	Blackwater (139)	Horn (140)	Pedro (141)	Wolf (142)	Klock (143)	Lahay (145)	Erables (147)	Biggar (148)	La Muir (149)
CLADOCERA																																				
Alona guttata																																				
A. quadrangularis																																				
Bosmina longirostris	●	●	●	●	●	●	●	●	●	○	●	●	●	●	○	●	●	●	●	●	●		○	○		●		●	●	●	○	●	●	●	●	●
Ceriodaphnia lacustris		○												○			○										○	○								
C. pulchella																													●							
Chydorus sphaericus							○		○		○			○	○			○					○							○				○	○	
Diaphanosoma leuchtenbergianum	○	●	●	○	●	●			●	○	○		○	○	●		●	○		○	○	●	○	○	○	○		●	●			●	○		●	●
Daphnia ambigua			○	○			○						○							○		○		○	○		○		○	○	○					
D. catawba	○											○				○		○	○	●				●	●		●			●						
D. dubia													○																							
D. galeata mendotae	○	○				○			○		○		●	○			○					○	●		●	○	○						○	●	○	●
D. longiremis	○			○							○		○	○	○		○			○	●		○								○			●		○
D. pulex					○						○		○																	○						
D. retrocurva	○				●			○							●		○				●	●	○	○	○			●	○		○			○	●	
Eubosmina tubicen			○	●	○			○	○							○					○		○	○					○					○		
Eurycercus lamellatus																																				
Holopedium gibberum	○	●	●	○	○	○	○	○	○	●	○	●	○		○	○	○	○	○	●	○	●		●	○	●	○	○	○	●	●			○	○	○
Ilyocryptus spinifer																																				
Latona setifira																																				
Leptodora kindtii								○				○	○		○		○									○							○			
Ophryoxus gracilis																																				
Polyphemus pediculus																													○					○	○	
Sida crystallina																							○													
COPEPODA																																				
Cyclops bicuspidatus thomasi		○	○	○				●	○		●		●		○		○	○			○	○	●	○	●	○		○						○		○
C. scutifer		○		○	○	●					●	○	○				○	○	●	●	○	○				●			○							○
C. vernalis																	○					○	○													
Diaptomus ashlandi																																				
D. minutus	●	●	●	●	○	●	●	●	●	●	●	●	●	○	●	●	●	●	●	○	○	●	●	●		●	●	●	○	●	●	●	●	●	○	●
D. oregonensis	○	○	○		●	○			○				○		○		○					○	○		●				○					○	●	
D. sanguineus																																				
D. sicilis					○																					○										
D. siciloides																																				
Epischura lacustris		○			○	○														○			○			○										○
Ergasilus sp.											○																									
Eucyclops speratus																																				
Limnocalanus macrurus																																				
Mesocyclops edax	○	○	○	○	○	○		○	○		○		○		○	○	○	○	○	○		●	○	○	○	○	○	○	○	○		○	○	○	○	○
Orthocyclops modestus																																				
Paracyclops fimbriatus																																				
Tropocyclops prasinus mexicanus	○	○			○			○	○		○		○	○	○	○	○				○	○	○	○				●	○					○		
# of Species	11	12	9	10	13	9	5	9	11	4	13	6	15	8	12	7	15	9	6	10	10	12	15	11	9	11	7	9	13	8	6	4	6	13	10	10
# of Dominants	2	4	4	3	4	4	2	3	2	2	4	3	4	1	3	2	3	2	3	4	3	5	3	4	4	4	2	5	3	4	2	3	2	4	4	4
# of Samples	4	5	5	6	6	5	5	5	6	6	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	4	4	4

SPECIES	LAKES																																			
	Proulx (150)	North Grace (151)	Chateau (152)	Foys (153)	Brule (154)	Buck (155)	Tim (156)	Bernard (157)	Bain (158)	Red Pine (159)	Smoke (160)	Louisa (161)	Hunter (162)	Magog (164)	Madawanson (165)	Kindiogami (166)	Bragh (167)	Kirby (168)	White Owl (169)	Rumsay (170)	Lost (171)	Thor (172)	Shining Tree (173)	Michaud (174)	Little Burwash (175)	Waonga (176)	Mary (177)	Helen (178)	Cooke (200)	Knight (201	McGrindle (202)	Mowatt (203)	Kasakanta (204)	Round (205)	Lang (206)	Halifax (207)
CLADOCERA																																				
Alona guttata			○															○																		
A. quadrangularis																																				
Bosmina longirostris	●	○	●	●	●	○	●	●	●	●	●	●	●	●	●	○	●	●	○	●	○	●	●	○	●		●	●	●	●	●	●	○	●	●	●
Ceriodaphnia lacustris	○	○	●						○											○			●						○							
C. pulchella																																				
Chydorus sphaericus							○	○		○									○							○										
Diaphanosoma leuchtenbergianum	●		○		○	●		○	●	○	●		○	●	○	○	●	●	●	●	●	●	○	●	○		○	○	○	●	○	○		●	○	
Daphnia ambigua			○						○											○										○	○	○				○
D. catawba		●	○				○																	○				○								
D. dubia	○	○		○	●		●			○	○	●	○		○	○			○			●			○					○						
D. galeata mendotae		○	○	●	○	○		○	○	●	○	●	○	○	○	○		○	○	○		○	●	○	●	●	●						●	●	●	
D. longiremis	○	○		○	●			○		●	●	○	○	○	○	○	○		○	○		●	○			○	○	○		○		○			○	○
D. pulex				●			○											○					●			●		○			○		●			
D. retrocurva	●		○	○		○		○	○		○					○	○		●		●						○		●	○	○	○		●	○	●
Eubosmina tubicen					○			○	○	○	○																○									○
Eurycercus lamellatus																																				
Holopedium gibberum	○		○	○	○	○	●	○	●	●	○	○	●		○	○	●	●	○	●	○	○		○	○		○	●	○	○	●	●	○	○	●	●
Ilyocryptus spinifer																																				
Latona setifira																																				
Leptodora kindtii								○			○			○	○			○				○									○			○		
Ophryoxus gracilis																				○																
Polyphemus pediculus						○		○			○									○																
Sida crystallina	○																										○								○	
COPEPODA																																				
Cyclops bicuspidatus thomasi	○				○	○	○	●	○	○	●	○	○	●	○	○	○					○			○	●	●				○	○	●	○	●	
C. scutifer				○	○			○		○		○			○	●				○	○	●		○	●			○		○	○	○	●			○
C. vernalis						○		○																												
Diaptomus ashlandi																																				
D. minutus	●	●	○	○	●		●	○	○	●	○	●	●	●	●	●	●		○		○	○		●	●	●	○	●	●	○	●	●	●	●	●	●
D. oregonensis	○	○			○	○			○	○	○	○			○	○	○		○	●	●	○	●		●	○	○	○		○	○	○	○	○	●	○
D. sanguineus																																				
D. sicilis														○																					○	
D. siciloides																																				
Epischura lacustris							○			○		○		○	○								○			○	○						○	○	○	○
Ergasilus sp.																																				
Eucyclops speratus				○																																
Limnocalanus macrurus														○																						
Mesocyclops edax	○	●		○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○	●			●	○		○	○		○			○	○	○	○
Orthocyclops modestus																		○														○				
Paracyclops fimbriatus																							○													
Tropocyclops prasinus mexicanus	●		●			○	○	○	○	○	○		○			○	●	●	○	●	○	○	●	○	○	○	○		○	○	●	●	○			○
# of Species	13	9	11	11	12	11	11	16	13	15	15	11	11	11	13	13	10	9	12	13	9	12	10	9	11	9	14	10	7	12	12	12	11	11	13	12
# of Dominants	5	3	3	3	4	1	4	2	3	5	4	4	3	4	2	2	5	4	2	5	4	5	6	3	5	4	3	3	2	2	4	3	5	5	6	4
# of Samples	4	4	4	4	4	4	4	5	5	5	4	4	5	5	6	5	5	4	5	5	5	5	5	5	5	5	5	5	2	3	3	2	2	2	2	2

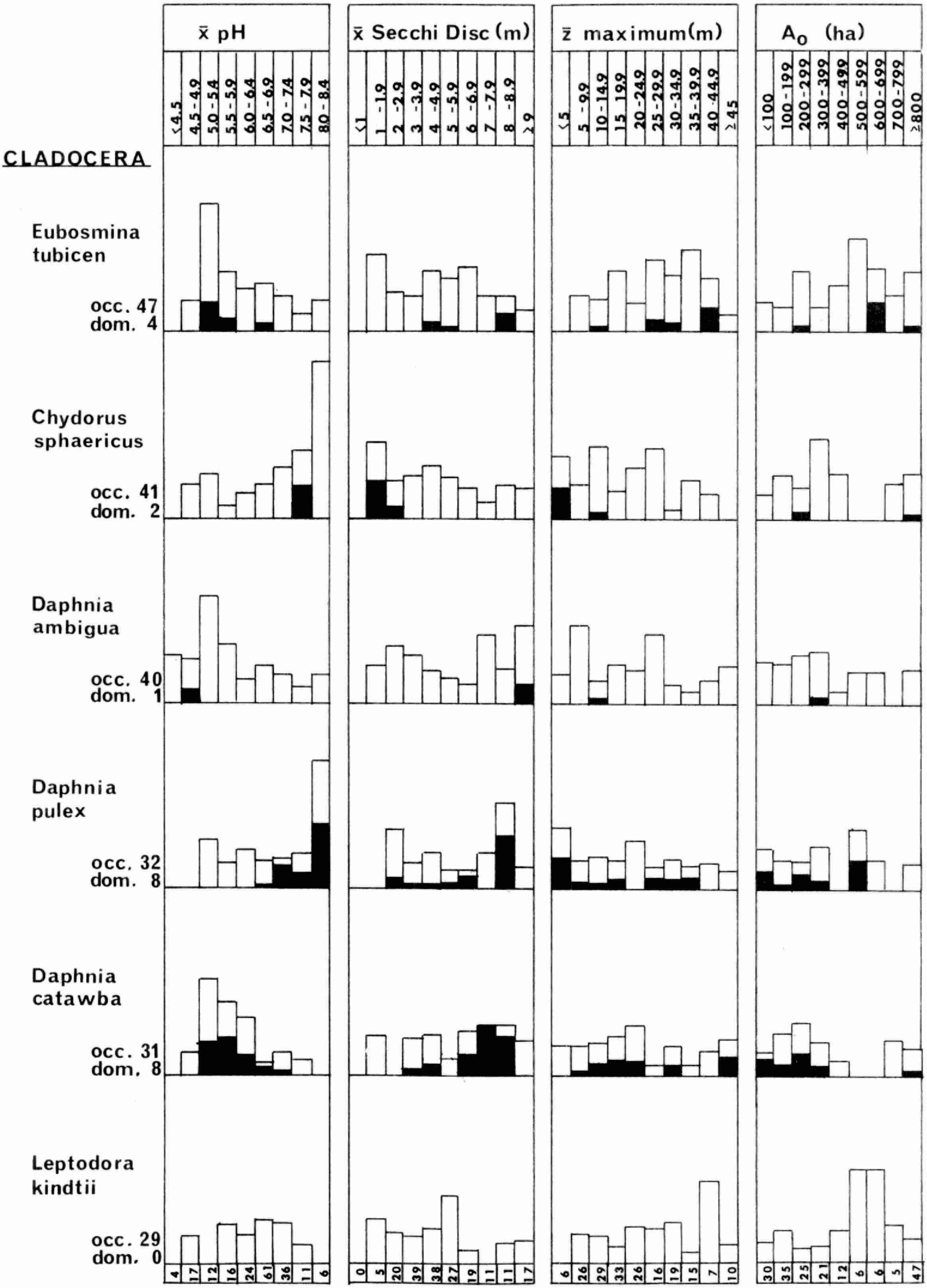
SPECIES	White Oak (208)	Burwash (209)	Rawhide (210)	Manitouwabing (211)	Basswood (212)	Rice (213)	David (214)
CLADOCERA							
Alona guttata							
A. quadrangularis							
Bosmina longirostris	●	●	○	●	●	●	○
Ceriodaphnia lacustris						○	
C. pulchella							
Chydorus sphaericus				○		○	
Diaphanosoma leuchtenbergianum	●	○		●			○
Daphnia ambigua						○	●
D. catawba						○	
D. dubia		●	○				
D. galeata mendotae		●	○	●		●	
D. longiremis			○			○	
D. pulex		○			○	○	
D. retrocurva				○			
Eubosmina tubicen							
Eurycercus lamellatus							
Holopedium gibberum	○	○	○		○	○	○
Ilyocryptus spinifer							
Latona setifira							
Leptodora kindtii							
Ophryoxus gracilis							
Polyphemus pediculus							
Sida crystallina							
COPEPODA							
Cyclops bicuspidatus thomasi		○	○	○			
C. scutifer		○	●	○		○	○
C. vernalis							
Diaptomus ashlandi							
D. minutus	●	●	●	●	●	○	●
D. oregonensis		○		○		○	
D. sanguineus							
D. sicilis							
D. siciloides							
Epischura lacustris					○	○	
Ergasilus sp.							
Eucyclops speratus							
Limnocalanus macrurus							
Mesocyclops edax		●		○		○	
Orthocyclops modestus							
Paracyclops fimbriatus							
Tropocyclops prasinus mexicanus		○				○	
# of Species	4	12	8	10	5	15	6
# of Dominants	3	5	2	4	2	2	2
# of Samples	2	3	2	2	2	1	2

APPENDIX B

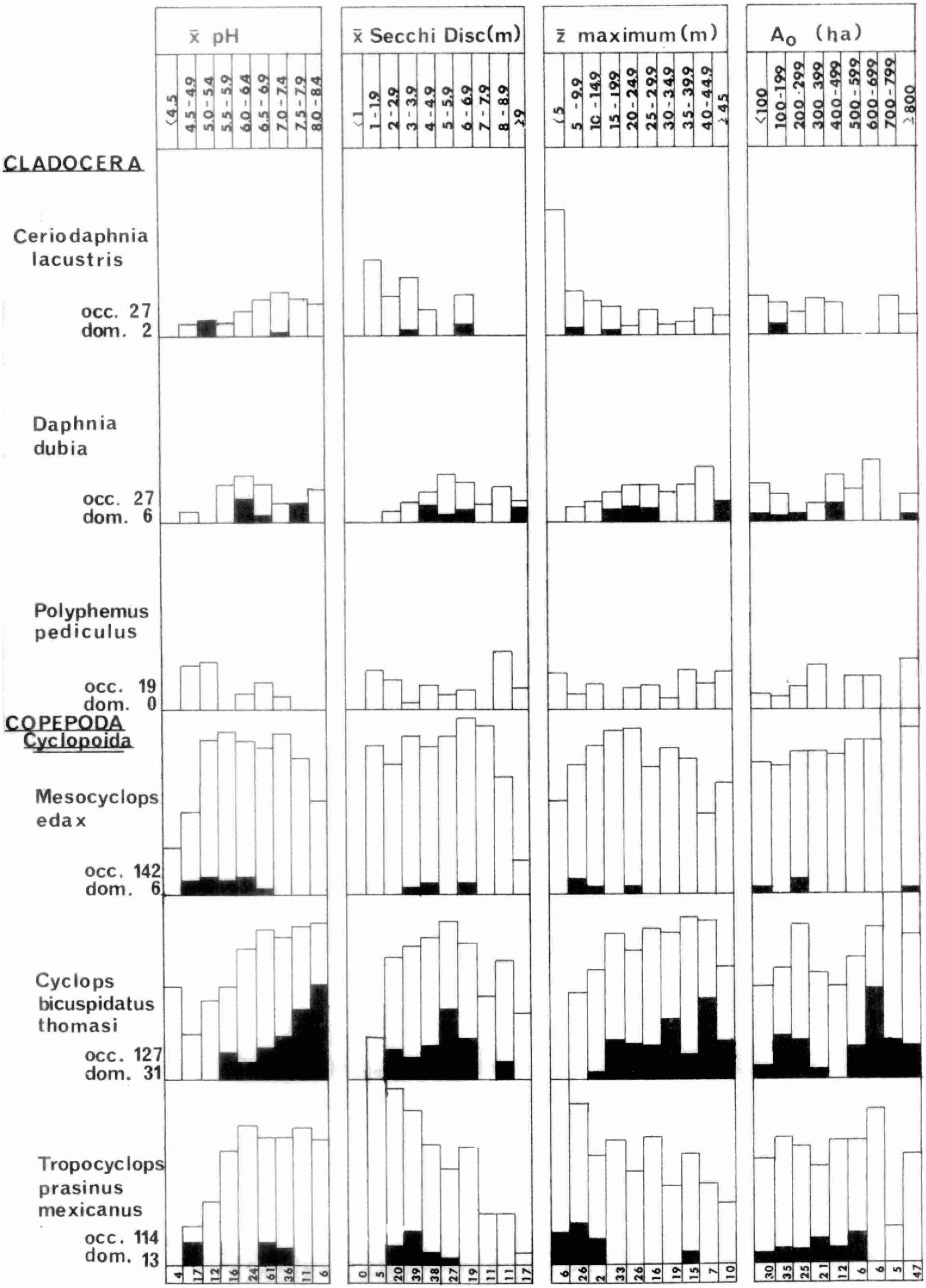
Histograms of the frequency of occurrence and dominance of individual species within lakes of varying pH, Secchi disc, depth ($\bar{Z}$ max - taken as maximum sampling depth) and area (A_O). The height of the vertical axis corresponds to 100% of the lakes within a particular category. The height of the open bar represents the percentage of lakes in which the species was present and the shaded portion indicates the percentage in which it was dominant. Occ indicates the total number of lakes in which a species occurred and Dom denotes the number of lakes in which it was present as a dominant. Numbers located on the bottom horizontal margin provide the number of lakes included in each category for physico-chemical parameters. Histograms are provided only for species occurring in > 5% of the study lakes .


x̄ pH
<4.5
4.5 - 4.9
5.0 - 5.4
5.5 - 5.9
6.0 - 6.4
6.5 - 6.9
7.0 - 7.4
7.5 - 7.9
8.0 - 8.4
x̄ Secchi Disc(m)
<1
1 - 1.9
2 - 2.9
3 - 3.9
4 - 4.9
5 - 5.9
6 - 6.9
7 - 7.9
8 - 8.9
≥9
z̄ maximum (m)
<5
5 - 9.9
10 - 14.9
15 - 19.9
20 - 24.9
25 - 29.9
30 - 34.9
35 - 39.9
40 - 44.9
≥45
A_o (ha)
<100
100 - 199
200 - 299
300 - 399
400 - 499
500 - 599
600 - 699
700 - 799
≥ 800
CLADOCERA
Bosmina longirostris
occ. 183
dom. 145
Holopedium gibberum
occ. 159
dom. 64
Diaphanosoma euchtenbergianum
occ. 146
dom. 55
Daphnia galeata mendotae
occ. 112
dom. 34
Daphnia longiremis
occ. 93
dom. 15
Daphnia retrocurva
occ. 92
dom. 27
4 17 12 16 24 61 36 11 6
0 5 20 39 38 27 19 11 11 17
6 26 29 33 26 16 19 15 7 10
30 35 25 21 12 6 6 5 47

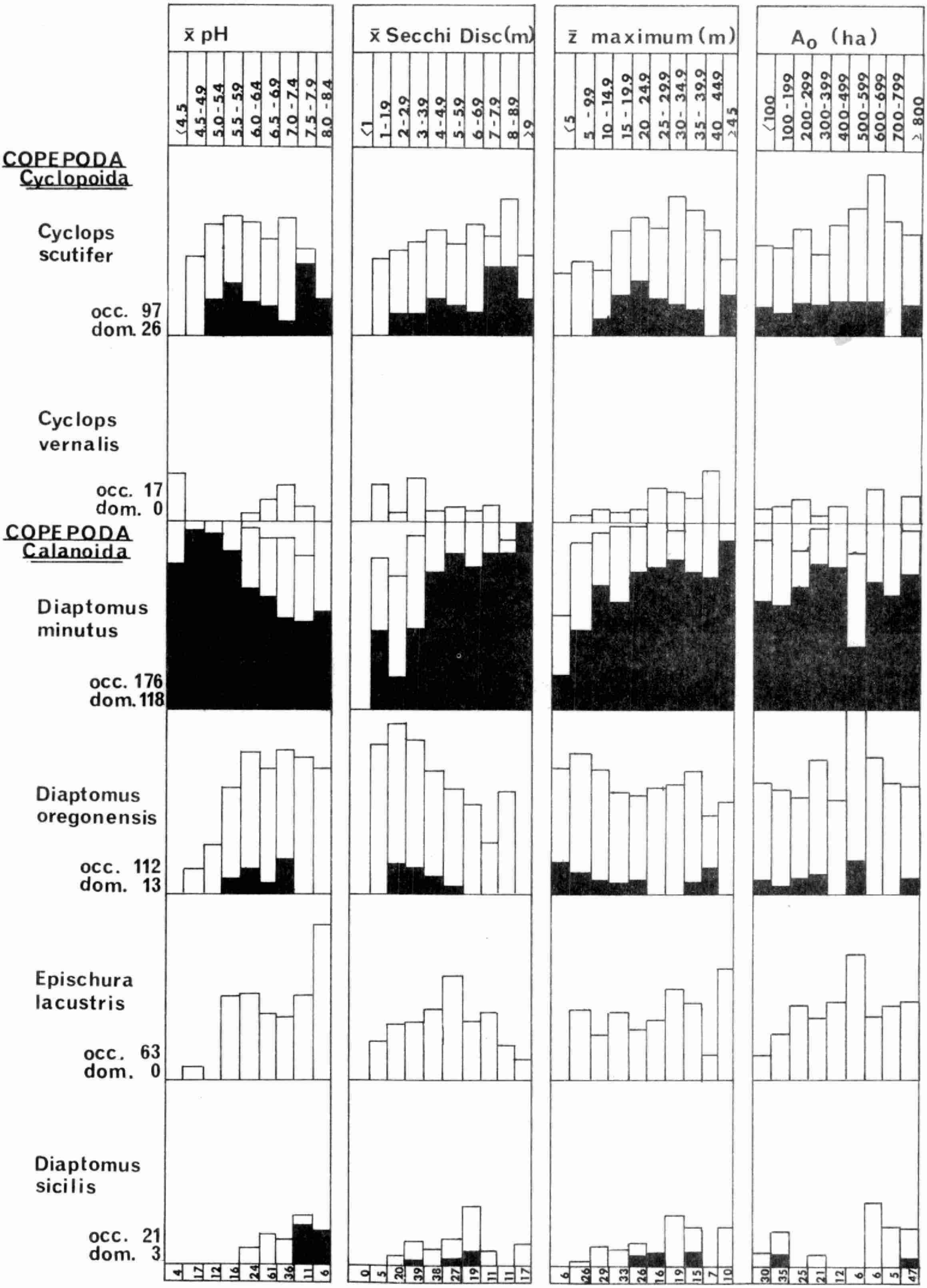
B2


x̄ pH
x̄ Secchi Disc (m)
z̄ maximum(m)
A$_o$ (ha)
<4.5
4.5-4.9
5.0-5.4
5.5-5.9
6.0-6.4
6.5-6.9
7.0-7.4
7.5-7.9
8.0-8.4
<1
1-1.9
2-2.9
3-3.9
4-4.9
5-5.9
6-6.9
7-7.9
8-8.9
≥9
<5
5-9.9
10-14.9
15-19.9
20-24.9
25-29.9
30-34.9
35-39.9
40-44.9
≥45
<100
100-199
200-299
300-399
400-499
500-599
600-699
700-799
≥800
CLADOCERA
Eubosmina tubicen
occ. 47
dom. 4
Chydorus sphaericus
occ. 41
dom. 2
Daphnia ambigua
occ. 40
dom. 1
Daphnia pulex
occ. 32
dom. 8
Daphnia catawba
occ. 31
dom. 8
Leptodora kindtii
occ. 29
dom. 0
4
17
12
16
24
61
36
11
6
0
5
20
39
38
27
19
11
11
17
6
26
29
33
26
16
19
15
7
10
30
35
25
21
12
6
6
5
47

B4


x̄ pH
<4.5
4.5 - 4.9
5.0 - 5.4
5.5 - 5.9
6.0 - 6.4
6.5 - 6.9
7.0 - 7.4
7.5 - 7.9
8.0 - 8.4
x̄ Secchi Disc(m)
<1
1 - 1.9
2 - 2.9
3 - 3.9
4 - 4.9
5 - 5.9
6 - 6.9
7 - 7.9
8 - 8.9
≥9
z̄ maximum (m)
<5
5 - 9.9
10 - 14.9
15 - 19.9
20 - 24.9
25 - 29.9
30 - 34.9
35 - 39.9
40 - 44.9
≥45
A0 (ha)
<100
100 - 199
200 - 299
300 - 399
400 - 499
500 - 599
600 - 699
700 - 799
≥800
CLADOCERA
Ceriodaphnia lacustris
occ. 27
dom. 2
Daphnia dubia
occ. 27
dom. 6
Polyphemus pediculus
occ. 19
dom. 0
COPEPODA
Cyclopoida
Mesocyclops edax
occ. 142
dom. 6
Cyclops bicuspidatus thomasi
occ. 127
dom. 31
Tropocyclops prasinus mexicanus
occ. 114
dom. 13
4
17
12
16
24
61
36
11
6
0
5
20
39
38
27
19
11
11
17
6
26
2
33
26
16
19
15
7
10
30
35
25
21
12
6
6
5
47

B5

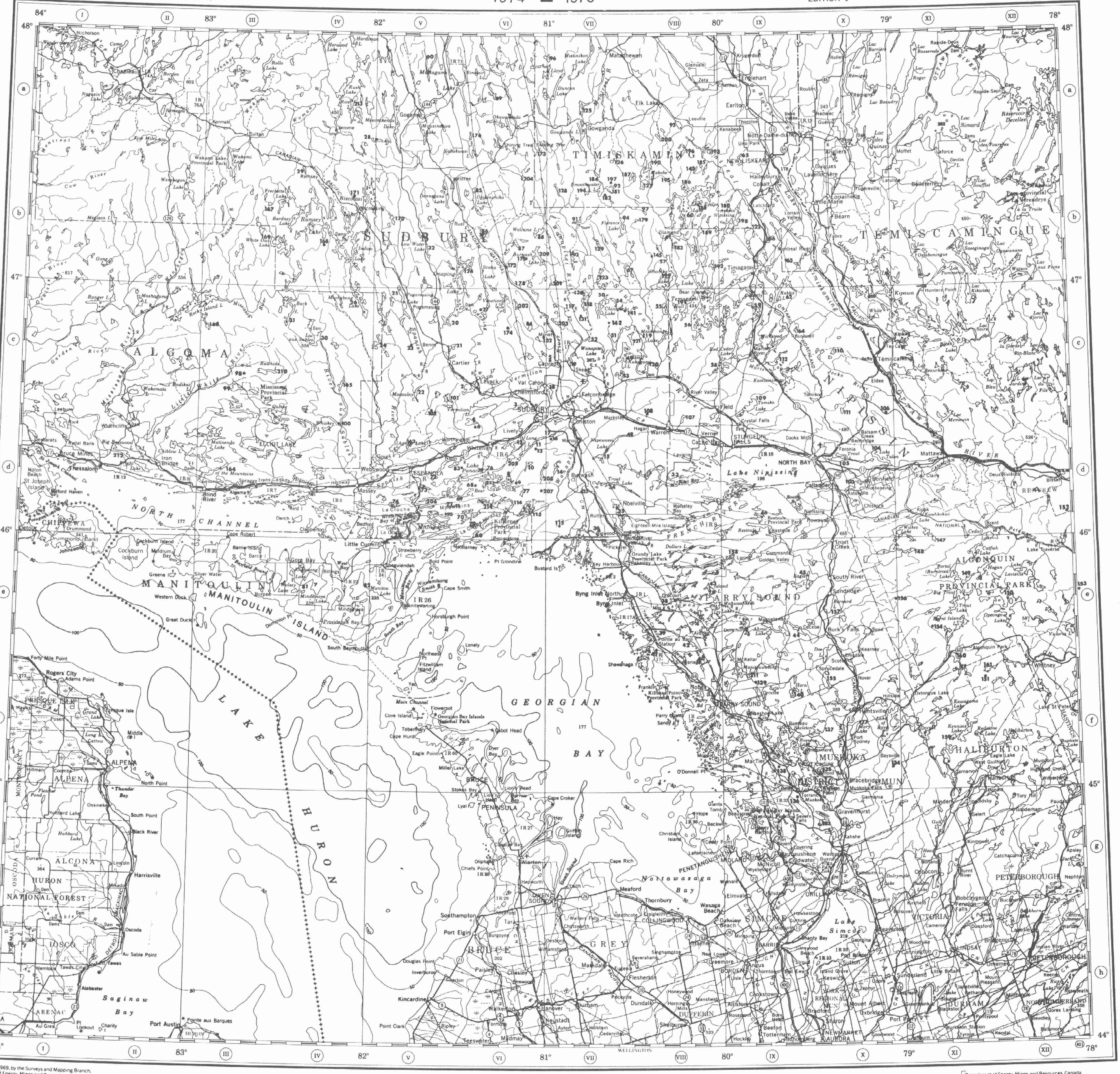

x̄ pH
x̄ Secchi Disc(m)
z̄ maximum (m)
A$_0$ (ha)
<4.5
4.5 - 4.9
5.0 - 5.4
5.5 - 5.9
6.0 - 6.4
6.5 - 6.9
7.0 - 7.4
7.5 - 7.9
8.0 - 8.4
<1
1 - 1.9
2 - 2.9
3 - 3.9
4 - 4.9
5 - 5.9
6 - 6.9
7 - 7.9
8 - 8.9
≥9
<5
5 - 9.9
10 - 14.9
15 - 19.9
20 - 24.9
25 - 29.9
30 - 34.9
35 - 39.9
40 - 44.9
≥45
<100
100 - 199
200 - 299
300 - 399
400 - 499
500 - 599
600 - 699
700 - 799
≥ 800
COPEPODA
Cyclopoida
Cyclops scutifer
occ. 97
dom. 26
Cyclops vernalis
occ. 17
dom. 0
COPEPODA
Calanoida
Diaptomus minutus
occ. 176
dom. 118
Diaptomus oregonensis
occ. 112
dom. 13
Epischura lacustris
occ. 63
dom. 0
Diaptomus sicilis
occ. 21
dom. 3
4
17
12
16
24
61
36
11
6
0
5
20
39
38
27
19
11
11
17
6
26
29
33
26
16
19
15
7
10
30
35
25
21
12
6
6
5
47

SUDBURY ENVIRONMENTAL STUDY
STUDY LAKE LOCATIONS
1974 — 1976

INTERNATIONAL MAP OF THE WORLD 1:1,000,000
CARTE INTERNATIONALE DU MONDE AU 1:1,000,000

EDITION 1

NL-17



Compiled in 1969, by the Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa, Canada.
Printed 1972.

Rédigée en 1969, par la Direction des levés et de la cartographie, ministère de l'Énergie, des Mines et des Ressources, Ottawa, Canada.
Imprimée en 1972

Lambert Conformal Conic Projection

Projection conique conforme de Lambert

SCALE 1:1,000,000 ÉCHELLE

Kilometres 10 5 0 10 20 30 40 50 60 70 80 90 100 110 Kilomètres

Compiled from
Rédigée d'après les

- Department of Energy, Mines and Resources, Canada Topographic maps 1:50,000 and 1:250,000
- Department of National Defence, Mapping and Charting Establishment, Canada Topographic maps 1:50,000 and 1:250,000
- Department of the Army, Army Map Service, USA. Topographic maps 1:250,000

TERMINAL STREAM: CREDIT R.

DATE	ISSUED TO
	Martin